



# **NEW INITIATIVES FOR BIRD CONSERVATION**



**Editors**

**Abraham Verghese, S. Sridhar, A.K. Chakravarthy  
Harish R. Bhat and Praveen Karanth**

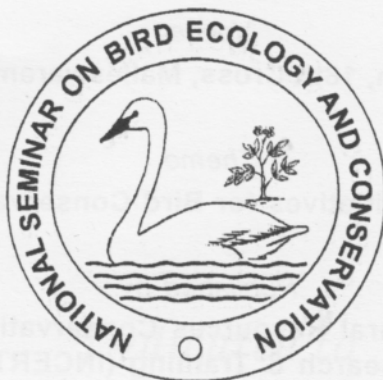
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**12th - 13th November, 2005, Bangalore, India**

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Cover : Greater Flamingos in the  
Tungabhadra Dam area,  
Bellary District, Karnataka  
Photo by Srenik Kumar N Baldota



*Dedicated to*

*Sir C.V. Raman*

*Prof. Satish Dhawan*

*and*

*Dr. Salim Ali*

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# Preface

***"Datyuharati Vikrandaihi Pumpsokilaruthairapi"***

*(On the onset of spring the waterfowls are attiring their notes  
and the cuckoos are singing)*

*(Kiskindhakanda, Valmiki Ramayana)*

These lines provide ample proof of the existence of birdwatching in India, since the days of Valmiki. Thanks to some British initiatives, birdwatching took firmer roots by the 18<sup>th</sup> century and flourished till independence. Later Dr. Salim Ali gave a major thrust with his "Book of Indian Birds", which was published by the Bombay Natural History Society. The launching of "Newsletter for Birdwatchers" by Mr. Zafar Futehally, in 1960 gave a much needed fillip to the birdwatching movement in India. The Newsletter continues to generate interest among 2000 bird enthusiasts in the country, many of them having graduated as professional ornithologists.

The first "National Seminar on Bird Ecology and Conservation" organized in Bangalore in 1993, was an outcome of these encouraging developments. This seminar was attended by over 250 delegates and two publications were brought out viz. "Bird Conservation Strategies for the Nineties and Beyond" and "Bird Diversity and Conservation - Thrusts for the Nineties and Beyond". They formed a valuable foundation beyond the frontiers of birdwatching to active conservation. Later, it was felt that another conclave of birdwatchers, ornithologists and ecologists for sustaining the momentum and starting new initiatives under one umbrella was overdue. So a second National Seminar on Bird Ecology and Conservation, on 12<sup>th</sup> and 13<sup>th</sup> November, 2005, was proposed and papers were invited. This Book is a collection of papers on "New Initiatives for Bird Conservation" encompassing a broad spectrum of forestry, biodiversity, agriculture, human health and so on.

The seminar papers cover a wide range of relevant topics. Forty-two papers are categorised under six sections. **Wetlands and Waterfowl** section consists of eight papers, majority of which are waterbird surveys. These papers recommend the declaration of certain wetlands as protected areas and discuss conservation strategies for the water bodies. **Bird Diversity and Conservation** section consists of fourteen papers and a majority of them are taxa specific that look at status and conservation of vultures, bustards, peafowl and babblers. The remaining papers are on avifaunal diversity in the Western Ghats. There are four papers in the **Applied Ornithology** section, three of which look at avian communities in agro-ecosystems and the fourth deals with the feeding potentials of two vulture species.

Four papers in **Bird Biology and Behaviour** section look at feeding, roosting and locomotory behaviour among raptors and waterfowl. In the **Current Issues** section, five articles on bird flu, mining, tsunami and avian biogeography, which are of interest to birdwatchers and the general public alike, are included. Therefore, this seminar can be termed as unique, for it not only focuses on birds but also takes a stimulating look at the implications on environment, conservation and public health. Further, the seminar has received seven papers from college students. To provide the young researchers with a platform for presenting and discussing their works, a **Student Session** is published as a supplement.

We thank Dr. N.S. Leela, the chairperson of the Technical and Students Session, for her untiring support and guidance, Mr. L. Vijay Kumar, Dr. A.C. Girish, (Research Scholars) UAS, GKVK, Bangalore and Mr. Pramod Subbarao for their editorial assistance. We also thank the publisher for critically examining the papers. We specially thank Mr. R. Ravishankar, Ms. Vimala Srinivasan, Ms. Shoba Anand, Ms. Kalavathi Srinivas, Ms. Pameela Girish, Mr. B. S. Srinatha, Mr. A. Sridhar, Mr. Narayanaswamy, Mr. Ristish and Mr. Shivalingaiah for rendering technical support.

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5<sup>th</sup> November 2005  
Bangalore.

**Editors**



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# Vulture Conservation Breeding Programme in South Asia

Devojit Das and Vibhu Prakash

Vulture Conservation Breeding Centre, BNHS Field Station  
B-2, Forest Complex, Pinjore - 134 102, Haryana

The Indian *Gyps* vultures i.e. white-backed vulture *Gyps bengalensis*, long-billed vulture *G. indicus* and Slender-billed Vulture *Gyps tenuirostris* are facing the threat of extinction due to various anthropogenic pressures particularly the use of veterinary drug, diclofenac. Strong evidence of the role of this non steroidal anti inflammatory drug has been provided recently, by the studies carried out in Pakistan and India, as a major cause of vulture mortality. The government has decided to phase out the manufacturing of the drug. However, enforcing the decree of banning the drugs along with introduction of its appropriate safe substitutes would take lot of time. The vulture will continue to die, even if it is in use in low quantities. The modeling study has shown that even if 0.5% of the cattle carcasses have lethal level of diclofenac it could cause the crash in vulture population to the extent witnessed during the last decade. The Conservation Breeding Programme is absolutely essential for preventing the extinction of the three species. The breeding programme will act as a buffer system to preserve a high proportion of

the original genetic diversity of the vulture population. The programme plans to establish six populations of each of the species in South Asia and each captive population would provide enough birds for one self sustaining wild population. A simple deterministic model shows that a captive vulture population of 25 pairs would be capable of producing a derived wild population of 100 pairs about 10 years after beginning of releases.

So far one breeding centre has been established and it is located at Pinjore, Haryana. Pinjore facility will provide expertise and technical support for the new vulture conservation breeding centres to be established in South Asia. The captive raised populations will be released back into the safe environment after making sure that the diclofenac has been removed from the system. Survival and breeding success of released individuals will be documented for determining the success of the reintroduction programme.

# Conservation priority for Black-breasted Parrotbill, Marsh Babbler and Jerdon's Babbler at the Dibru-Saikhowa Biosphere Reserve

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## Introduction

Some of the remaining parts of tall grasslands in India, are found in the flood plains of Assam where the regional conservation priority of species diversity has been of prime interest to biogeographers. The birds of the tropical grasslands of the Indian subcontinent are the most threatened and the least studied element of avifauna. Being the center of endemic avian species of Assam area, all the grasslands of Brahmaputra valley is ecologically important because most of the threatened species are breeding residents of grasslands. The Dibru-Saikhowa Biosphere Reserve (DSBR) is entirely situated in the flood plains of Brahmaputra River where all the three endemic species of Assam area are found. Surrounded by many villages and the two villages inside the park boundary of DSBR, it is a major concern for the management and conservation, where the anthropogenic pressure is severe in different ecosystems including the grasslands. With about 9,000 cattle population inside the park boundary the grassland ecosystems are severely affected, where the diversity and the population of endemic avian species is declining at an alarming rate. These fragmented and degraded grasslands need urgent management steps for the conservation of residential endemic grassland birds that need habitat requirements more at micro level.

## Objectives of the Study

The grassland of Dibru-Saikhowa are not only ecologically important but also shelter the endemic birds of Assam with the species like Black-breasted Parrotbill *Paradoxornis flavirostris*, Marsh Babbler *Pellorneum palustre*, and the Manipur Bush Quail *Perdicula manipurensis*. These are the three species that have been identified by Bombay Natural History Society (BNHS) in their Important Bird Areas (IBA) programme for the Assam area as a part of the Endemic Bird Areas of India. But during the last two years of our bird survey not a single sighting of

Manipur Bush Quail *Perdicula manipurensis* has been recorded. So the present studies propose to analyze the level of disturbances to see the resultant impact on the three monitor species i.e. Black-breasted Parrotbill *Paradoxornis flavirostris*, Marsh Babbler *Pellorneum palustre* and Jerdon's Babbler *Chrysomma altirostre*.

## Material and Methods

There are four stages in this field work which include

- a) Pre-field stage consists of collection of data, review of literature
- b) Field stage consists of systematic collection of primary data in the field.
- c) Post-field stage consists of analysis and interpretation of all the data using appropriate methods.
- d) Finally, on the basis of all these field works and analysis, the literary work of this paper is prepared. The fieldwork covered three different categories of grasslands as given below.
  - i) Relatively less disturbed grasslands.
  - ii) Moderately disturbed grasslands.
  - iii) Highly disturbed grasslands.

For the collection of data, line transect method were adopted. Moreover, the researcher himself did the extensive still photography of grassland birds with telephoto lenses.

The limitations of this fieldwork may be outlined as follows:

- i) Secondary data were not sufficiently available in the field of grasslands especially for the avifauna in this particular field.
- ii) Neither any previous work nor any literatures on the grassland birds of this region are available.



- iii) Flood is a serious hazard in Dibru-Saikhowa National Park for any scientific field study. Hence the collection of data during the rainy season was a very difficult task.
- iv) The visibility is quite difficult due to tall and dense grassland in the study area. Hence reliance on birds call and the accurate identification is very much essential for data collection.
- v) Moreover, there are some other problems like inclement weather, threat of wild animals like buffalos, elephants and also hindrances posed by numerous nalas (streams) and wetlands inside the grasslands during rainy season.

### Study Area

Situated in the eastern most part of India, this National Park is about 13 km north of Tinsukia Town. With about 380 species of avifauna, this park covers an area of about 340 Sq. km. as core area along with about 425 Sq. km. of buffer zone. With approximately 27° 30' N to 27° 48' N latitude and 95° 03' E to 95° 35' E longitude, this park is the third largest in Assam after Kaziranga and Manas. Bordered by the Brahmaputra on its Northern side and Dibru-river on its south, Dibru-Saikhowa was declared a National Park in 1999.

The Park is situated in the flat alluvial flood plains of the Brahmaputra and the Lohit River at an altitude of about 118 m above mean sea level. There are some prominent geomorphological evidences that show the marks of rapid changes both in the course of river

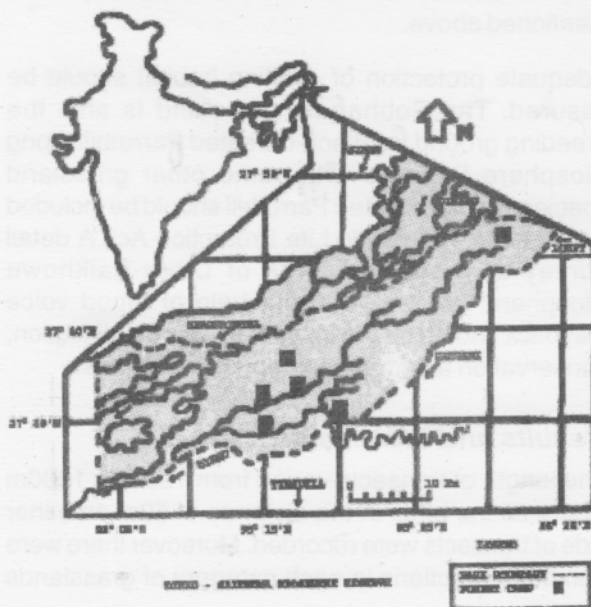
and streams and in its geomorphological characteristics after the great Assam earthquake of 1950. So the entire biogeography of the Park has been influenced by these changes and the change is still going on. Another important topographical change that determines the biodiversity and bio-ecology of Dibru-Saikhowa National Park is the heavy siltation and massive river erosions every year in the monsoon season.

The Park is situated in the belt of tropical monsoon climate where it enjoys a tropical summer with maximum of 34°C and cool dry winter with minimum of 7°C. The annual rainfall ranges from 2300 mm to 3800 mm and the rainy months are June, July, August and September, of June, July and August are the hottest and December and January are the coldest of months.

### Habitat Characteristics of the Three Categories of Grasslands

The characteristic features of grasslands of this biosphere reserve are that it is heavily silted as well as eroded after every flooded season. Hence, along with anthropogenic pressure the natural impact of flood is very intense and is so prominent that the intensity of flood and erosion is gradually increasing year after year. The main grass species are: *Saccharum spontaneum* (Kohua), *Arundo donax* (Nal), *Cynodon dactylon* (Dubori), *Imperata cylindrica* (Ulukher), *Phragmites karka* (Khagori), *Erianthus ravennae* (Ikora), *Vetiveria zizanioides* (Birina), *Tamarix dioca* (Jhao) etc.

**Raidang grassland**, the highly disturb grassland is predominantly covered by *Tamarix dioca* in newly formed grassland and *Arundo donax* with patchy degraded forest. There are at least ten illegal cattle farm at the fringe of National Park from where every morning hundreds of domestic buffalos go for heavy grazing and there is loss of habitat that affects the avian fauna of Raidang. Four years back Raidang grassland was inhabited by the one of the endemic species i.e. Black- breasted Parrotbill *Paradoxornis flavirostris*. As the buffalo are course feeder, the tender grass has been suppressed up to the ground level and due to heavy grazing resulting the compactness of soil increase the growth weeds that directly effect the bird population. During the recent surveys it was revealed that not a single sighting of these vulnerable and rapidly declining grassland species i.e. the Black- breasted Parrotbill *Paradoxornis flavirostris*, Marsh Babbler *Pellorneum palustre* and Jerdon's Babbler *Chrysomma altirostre*



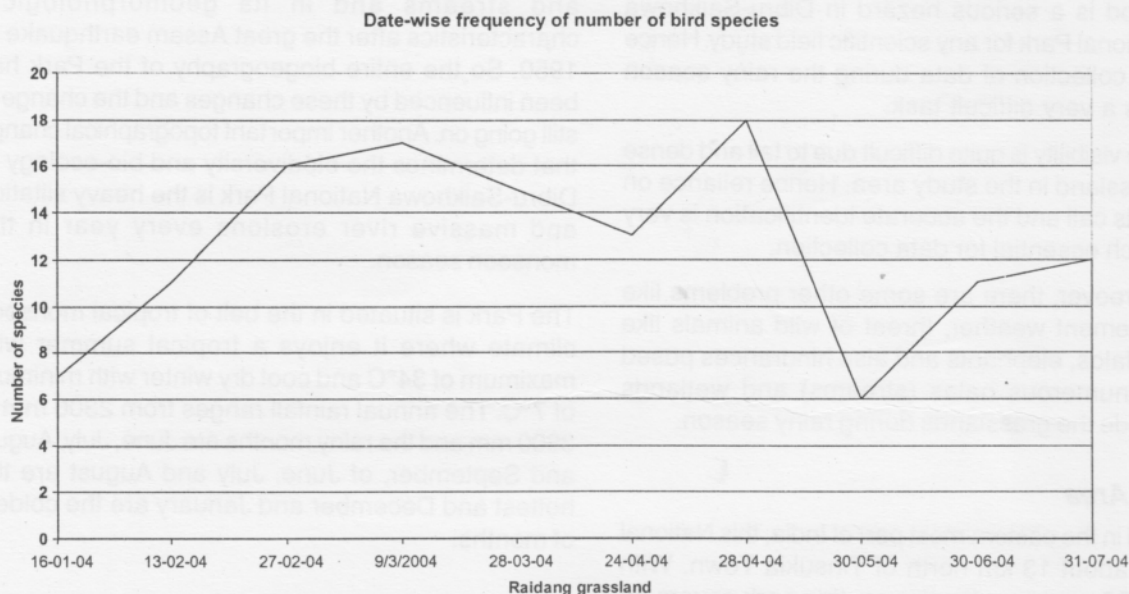


Fig.1 Number of species counted in the first ten days. (Raidang)

has been recorded in this area which has become locally extinct from this patch of grassland.

The vegetation of moderately disturbed grassland i.e. the **Kundaghat grassland** also has similar species of grasses but the influence of *Tamarix dioca* is significantly less that indicates that this grassland is of relatively old in nature. But it has the influence of woodland on the one hand and the rapidly eroding Kolomy *nala* on the other. The rapid erosion is due the movement of motorboats during the rainy season from the interior village of *Laika*. The grassland has the most important vulnerable and rare endemic species i.e. the Marsh Babbler *Pellorneum palustre*. But surprisingly there were not a single record of Black-breasted Parrotbill *Paradoxornis flavirostris* as the density of this grassland is comparatively low and in some places it is fragmented by *nalas* and scattered, degraded secondary forest.

The third category of grassland i.e. the **Sobhanala grassland** which is relatively less disturbed has the highest density of vegetation and contains almost all the species of grasses mentioned earlier. It is a large patch of tall grasses inhabited mostly by Elephant and Asiatic Water Buffalo where there is total absence of woodland vegetation. Most of the area of Sobhanala grassland is covered with thick tall grasses that are suitable habitat for Black-breasted Parrotbill, Marsh Babbler, and Jerdon's Babbler. All the sighting records of Black-breasted Parrotbill, were from this grassland. Apart from this

species there were considerable number of sighting records of Marsh Babbler and Jerdon's Babbler. But the major threat to this grassland is the river erosion where the river Dangori is shifting towards North of this grassland. The other threat is the domestic cattle of Raidng area that are gradually moving towards this grassland where the effect has already been recorded during the bird survey in the western margin of vast Sobhanala grassland. Without proper management and measures to check this illegal movement of domestic cattle, this grassland will also be affected and the habitat destruction will lead the removal or local extinction of the three endemic species mentioned above.

Adequate protection of existing habitat should be assured. The Sobhanala grassland is also the breeding ground for Black-breasted Parrotbill along Biosphere Reserve with some other grassland species. Black-breasted Parrotbill should be included in schedule – 1 of Wild Life Protection Act. A detail survey of grassland birds of Dibru-Saikhowa Biosphere Reserve with the help of taped voice playback should be the initial stage for identification, conservation and management of grasslands.

### Results and Discussion

The length of transects varied from 100m to 1000m where all the birds in the distance of 50m on either side of transects were recorded. Moreover there were number of sections in each category of grasslands



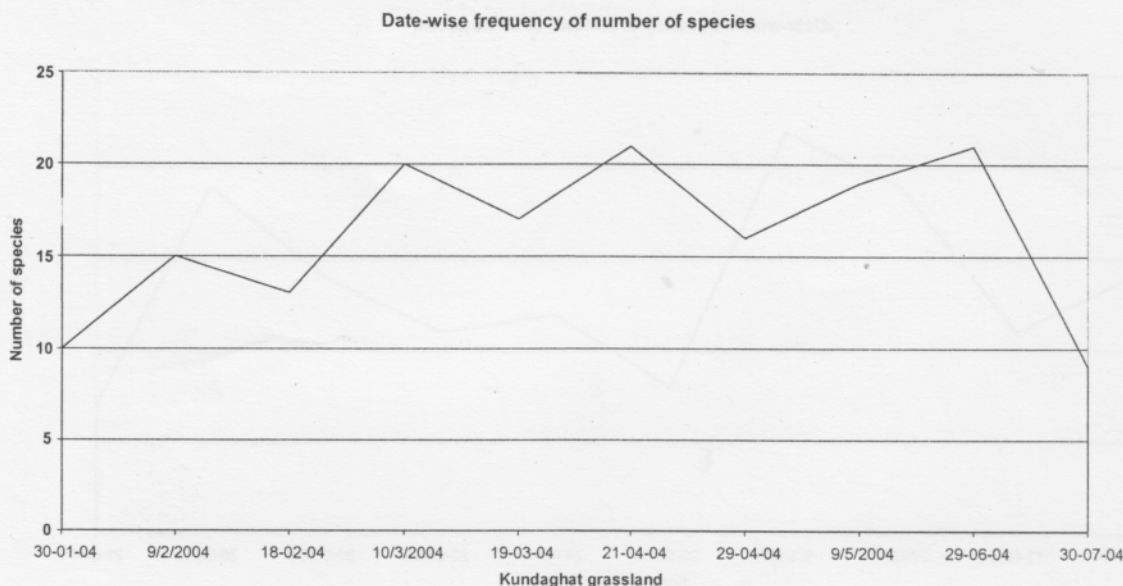


Fig.2 Number of species counted in the first ten days. (Kundaghat)

to record the habitat type along with the bird species. Routine counts were done since 16-01-04 in all the three categories of grasslands covering all transects at least once a month so that; seasonal pattern of avian diversity can be assessed. So the survey covered all the four seasons of the year from 16-01-04 to 21-08-05 which were done early in the morning when the birds are very active.

More than 156 hours of walk in three categories of grasslands having 3 major transects have been covered. There were 22 visits to Sobhanala, 21 to Raidang and 24 to Kundaghat. Out of the 2849 individual birds, 912 were seen in Raidang grassland 1158 in Kundaghat grassland and 779 in Sobhanala grassland. A total of 161 bird species representing 38 families were recorded from three grasslands where highly disturbed Raidang had 46 species, Kundaghat with 51 species which is moderately disturbed and with 64 species Sobhanala is relatively less disturbed grassland. Of the 161 species recorded in transects, 51 are identified as obligate grassland birds which are totally dependent on grassland habitat. Out of 38 families recorded in the grasslands; Raidang had 29, Kundaghat had 35 and Sobhanala had all the 38 families.

The frequency with which different individual bird species were counted varied from a single observation to 203 observations. Yellow-bellied Prinia had the highest frequency of 203, Chestnut-

capped Babbler was the second highest with 177 and the third was the Common Stonechat with 148 individuals.

Comparing diversity among habitats shows that disturbed habitat supported less diversity than relatively undisturbed habitat. Relatively undisturbed habitat supported short geographical distribution range species or Restricted Range Species whereas, disturbed habitat supported the more wide spread species. The survey reveals that disturbances negatively affect the endemic species whereas, it positively affects widespread species. Therefore diversity depends not only on richness, but also on evenness. Evenness compares the similarity of population size of each of the species present. As species richness and evenness increases, the diversity increases.

Here in this study to measure the diversity, Simpson's Diversity Index was used which takes into account both richness and evenness. According to Simpson's Diversity Index,

$D = \sum (n / N)^2$  Where,  $n$  = the total number of organisms of a particular species.  $N$  = the total number of organisms of all species.

Or

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

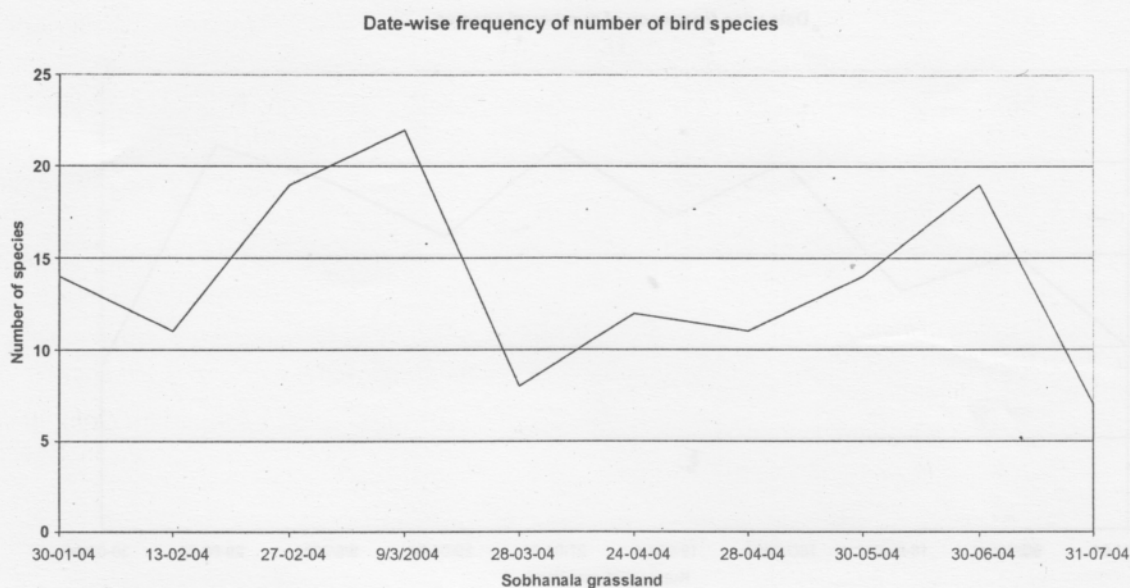


Fig. 3 Number of species counted in the first ten days. (Sobhanala)

The Simpson's Diversity Index of three monitor species is as follows:

Black-breasted Parrotbill *P. flavirostris*: 0.00020

Marsh Babbler *P. Palustre*: 0.00017

Jerdon's Babbler *C. altirostre*: 0.00010

On the other hand the Simpson's Diversity Index of most frequently observed bird species are as follows:

Yellow-bellied Prinia *Prinia flaviventris*: 0.0050

Chestnut-capped Babbler *Timalia pileata*: 0.0038

Common Stonechat *Saxicola torquata*: 0.0026

After analysis of the data it can be stated that grassland of Dibru-Saikhowa Biosphere Reserve is facing a great threat of habitat destruction. Both anthropogenic and natural disturbances are very acute in nature. Two main factors that can be highlighted for habitat destruction are:

- a) Large scale riverbank erosion and siltation resulting reduction of grassland habitat.
- b) Over-grazing by domestic cattle destroying the grassland habitat.

Though there is richness in species diversity, the evenness of species is very low. The lack of evenness was very clear after monitoring the distribution pattern of Black-breasted Parrotbill, Marsh Babbler & Jerdon's Babbler, which are restricted to few dense grasslands having constant threat of natural, and anthropogenic pressure. Moreover it should be noted that some of the frequently observed

species have some how adapted themselves to the disturbed habitat but the three monitor grassland species were found to be restricted and confined in the few pockets of relatively less disturbed grasslands. The pressure by uncontrolled overgrazing of domestic stock is severe in most of the grasslands and the Raidang grassland is an example for the total habitat loss where not a single species of the three monitor species were recorded in the field survey though this patch of grassland was formerly inhabited by these three species.

So, it can be concluded that there is a constant threat of local extinctions of Black-breasted Parrotbill, Marsh Babbler & Jerdon's Babbler in Dibru-Saikhowa Biosphere Reserve which is also one of the last resorts in the world for the Black-breasted Parrotbill because; sightings of this species have been reported only from the Kaziranga and Dibru-Saikhowa N.P of the Brahmaputra valley of Assam.

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# Bird Community in the high Altitude Grassland, Upper Bhavani, Nilgiris

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## Introduction

Species diversity, is one of the three principle levels of biological diversity, which include genetic diversity within species, species diversity and ecosystem or community diversity. Based on most of the environmental assessment, biodiversity is identified as synonymous with species diversity and measured by the number of species in an area – the species richness (Kempton, R.A, 2002). The structure and composition of bird communities are known to vary in different vegetation types (Wiens *et al.* 1989).

Grasslands contain relatively homogeneous vegetation patterns that lack structural diversity, or patchiness, thus limiting the number of bird species that can exploit them (Roth 1976). In order to interpret information about diversity we need to understand a very important principle. Spatial and temporal distribution pattern of species are related to various ecological factors and processes (Burel 1992). The distribution of living organisms is influenced by abiotic factors such as the amount of rainfall, soil pH, temperature and so on. The more extreme abiotic conditions, the fewer the species that can survive and, therefore we used this principle to compare the diversity of bird species found in the Montane grasslands with the amount of rainfall and the mean temperature in upper Nilgiri grasslands. The annual rainfall of Nilgiris from 500 mm to 7000 mm and the

temperature ranges from 0°C during winter to 41°C during summer (Figure 1). The Nilgiris have been undergoing drastic changes in the landscape with the replacement of forests and grasslands by monoculture plantations and agriculture (Gokula & Vijayan 1996). Grassland environments are characterized by extreme environmental conditions, including intense solar radiation. The objective of the study was to evaluate the structure of species composition of bird communities in wet grasslands. Correlation between the species abundance, rainfall, and temperature and seasonal changes in these bird community also studied.

## Study Area

Our study was carried out in Upper Bhavani, Tamil Nadu, located in the border of the Mukurthi National Park, Nilgiris. Upper Bhavani, about 60 kilometres from Ooty, is one of the entry points to the Mukurthi National Park. The temperatures vary from 0 to 30°C in the grasslands during the dry season, but remain constant around 15° C in the sholas. Upper Bhavani has pronounced rainy period in the monsoon.

## Material and Methods

Bird surveys were conducted each month to determine the presence of birds within the 10 ha area of grasslands. Point count method was employed to

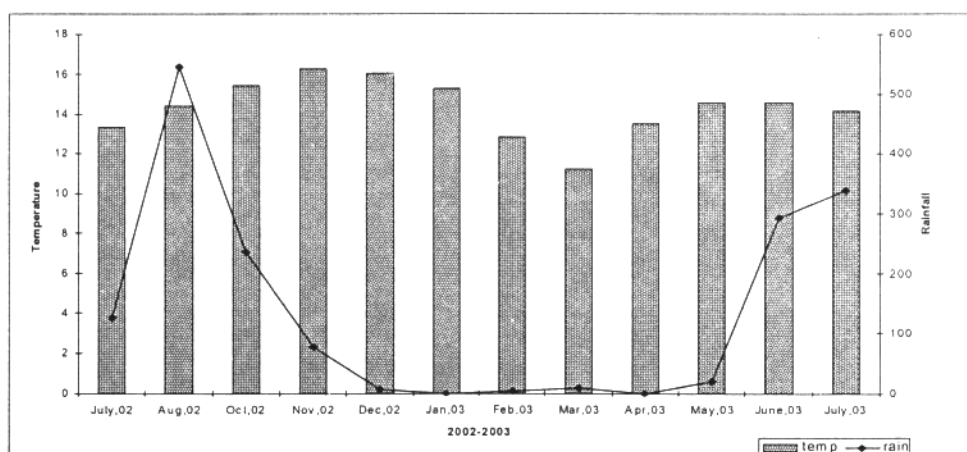


Figure 1. Rainfall and temperature during 2002-2003

count the birds during July 2002- July 2003. In each point we recorded species, number of individuals, and the distance from the point. Birds were identified using binoculars, or by listening to their call. Characteristic grassland species were analyzed. The species diversity was calculated using Shannon Wiener Index ( $H' = -\sum(p_i \ln p_i)$ ) with the program SPIDIVERS. BAS developed by Ludwig and Reynolds (1988). We analyzed the correlation between the number of individuals observed and number of species in 4 seasons with rainfall and temperature by using the Wilcoxon Matched-Pairs Signed-Ranks Test and to find the most dominant species in the grassland, applied the Dominance index (Dominance index =  $n_i \times 100/N$ )

## Results

The number of bird species seen in a given habitat is less. A total of 332 birds were counted during the survey. Number of birds species observed from the 10 ha area was 24 with diversity index (1.03) including only 6 grassland birds and the other 18 associated

| <b>Table 1. Bird community in the Upper Bhavani grassland</b> |  |
|---------------------------------------------------------------|--|
| <b>A: grassland –dependent species</b>                        |  |
| Nilgiri Pipit                                                 |  |
| Paddyfield Pipit                                              |  |
| Pied Bushchat                                                 |  |
| Prinia                                                        |  |
| Grey Wagtail                                                  |  |
| Common Snipe                                                  |  |
| <b>B: Associated with trees or Generalists</b>                |  |
| Black and Orange Flycatcher                                   |  |
| Black Bird                                                    |  |
| Black Bulbul                                                  |  |
| Common Chiffchaff                                             |  |
| Grey Headed Flycatcher                                        |  |
| Grey Jungle Fowl                                              |  |
| Great Tit                                                     |  |
| India Scimitar Babbler                                        |  |
| Jungle Crow                                                   |  |
| Kestrel                                                       |  |
| Nilgiri Flycatcher                                            |  |
| Nilgiri House Swallow                                         |  |
| Rose Finch                                                    |  |
| Red Whiskered Bulbul                                          |  |
| Tickell's Leaf Warbler                                        |  |
| Tytler's Leaf Warbler                                         |  |
| White Breasted Shortwing                                      |  |
| White-eye                                                     |  |

with trees or generalist habitats in the Upper Bhavani Grassland (Table 1). Grassland species were defined as those feeding and breeding mostly in grassland habitats. The high species richness was found in summer and lowest was in Southwest monsoon, the dispersal after the immediate breeding might be caused this sudden decrease.

Occurrence of bird species in different seasons over the study period is given in table 2. The Pied Bushchat, Ashy Prinia, Jungle Crow and Great Tit were recorded in all seasons, Nilgiri Pipit was not found in Northeast monsoon, may be due to the low accessibility in the grass, Paddyfield Pipit was spotted both in winter and summer but not during monsoon as it migrates after breeding in the high altitude, Rose Finches were recorded only in summer, Grey Wagtail was found in Northeast monsoon and winter.

| <b>Table 2 : Occurrence of birds at Upper Bhavani in different seasons (2002-2003)</b> |            |            |         |         |
|----------------------------------------------------------------------------------------|------------|------------|---------|---------|
|                                                                                        | South west | North east | Sum-mer | Win-ter |
| Black and Orange Flycatcher                                                            | -          | p          | -       | -       |
| Black Bird                                                                             | -          | -          | p       | p       |
| Black Bulbul                                                                           | -          | p          | p       | p       |
| Common Chiffchaff                                                                      | -          | -          | p       | p       |
| Common Snipe                                                                           | -          | -          | p       | -       |
| Great Tit                                                                              | p          | p          | p       | p       |
| Grey Wagtail                                                                           | -          | p          | p       | -       |
| Indian Scimitar Babbler                                                                | -          | p          | -       | p       |
| Jungle Crow                                                                            | p          | p          | p       | p       |
| Indian Kestrel                                                                         | -          | -          | p       | -       |
| Leaf Warbler                                                                           | -          | p          | -       | -       |
| Nilgiri House Swallow                                                                  | -          | p          | -       | p       |
| Nilgiri Flycatcher                                                                     | -          | p          | p       | p       |
| Nilgiri Pipit                                                                          | p          | -          | p       | p       |
| Paddyfield Pipit                                                                       | -          | -          | p       | p       |
| Pied Bush Chat                                                                         | p          | p          | p       | p       |
| Prinia                                                                                 | p          | p          | p       | p       |
| Rose Finch                                                                             | -          | -          | -       | p       |
| Red-whiskered Bulbul                                                                   | -          | -          | -       | p       |
| Tickell's Leaf Warbler                                                                 | -          | p          | p       | p       |
| Tytler's Leaf Warbler                                                                  | -          | p          | p       | p       |
| White bellied Shortwing                                                                | -          | p          | -       | p       |
| White Eye                                                                              | -          | p          | p       | -       |



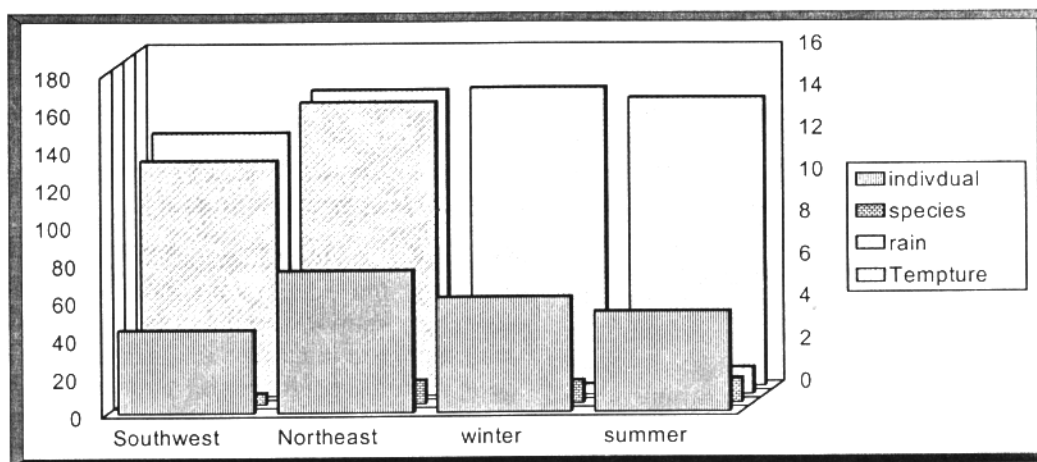


Figure 2. Seasonal variation of species number with mean temperature (2002-2003)

We analyzed the correlation between the numbers of individuals species in 4 seasons with rainfall and temperature (Figure 2). There was a significant relationship in number of species present in the area with rainfall ( $Z = -1.8363$ ;  $P = 0.06$ ) and the temperature ( $Z = -2.2014$ ;  $P = 0.02$ )(Figure 2). The Pied Bushchat is the most common and dominant species at Upper Bhavani grasslands (Table 3).

**Table 3 Dominance index of selected species at Upper Bhavani (wet grassland)**

| Sl. No. | Species                             | Dominance index |
|---------|-------------------------------------|-----------------|
| 1.      | <i>Saxicola caprata</i>             | 15.88           |
| 2.      | <i>Anthus nilghiriensis</i>         | 9.70            |
| 3.      | <i>Prinia socialis</i>              | 9.70            |
| 4.      | <i>Muscicapa albicaudata</i>        | 9.41            |
| 5.      | <i>Corvus macrorhynchos</i>         | 8.23            |
| 6.      | <i>Hypsipetes medagascariensis</i>  | 7.94            |
| 7.      | <i>Parus major</i>                  | 7.35            |
| 8.      | <i>Phylloscopus affinis affinis</i> | 6.76            |
| 9.      | <i>Zosterops palpebrosa</i>         | 5.29            |
| 10.     | <i>Hirundo tahitica domicola</i>    | 4.41            |
| 11.     | <i>Anthus novaeseelandiae</i>       | 3.82            |
| 12.     | <i>Phylloscopus tytleri</i>         | 2.64            |
| 13.     | <i>Pomatorhinus schisticeps</i>     | 1.76            |
| 14.     | Leaf Warbler                        | 1.47            |
| 15.     | <i>Carpodacus erythrinus</i>        | 1.17            |

## Discussions

Grassland of the Upper Bhavani has features that explain their low avian species richness. Wiens (1973) pointed out that grassland sites have a low and relatively constant number of breeding species and that desert sites have low bird densities. The Pied Bushchat reached a high dominance in the Nilgiris grasslands. When the other generalists also were included, comparatively moderate species diversity might be affected by the surrounding habitats. With the results, we can conclude that there could be a significant relationship with the temperature variation in different seasons and the number of species. Overall lower population densities might be due partly to the loss of grassland habitat in Upper Bhavani and resulting decline in grassland bird populations and densities. Seasonal variation in bird assemblages might be related to alternation between rainy and dry periods (Capurro and Bucher 1986; Poulin *et al.* 1992). In this context, both the temperature and the rainfall have important role in the seasonal variation of bird assemblages similar to the bird community in the West Pampa grasslands of Argentina (Isach *et al.* 2003). Despite the low richness, recorded, the presence of certain rare species such as Nilgiri Pipit one of the near threatened species, add conservation value to the Montane grasslands in the Western ghats.

## Acknowledgements

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# Rehabilitating the Great Indian Bustard at the Ranibennur Sanctuary

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## Introduction

This paper deals with the appearance and disappearance of the endangered "Great Indian Bustard (*Choriotis nigriceps*)" at the Ranibennur Sanctuary and its rehabilitation.

The Bustard was commonly spotted in this Ranibennur ecosystem at the end of the 19<sup>th</sup> century as recorded in the Bombay Gazetteer of the Dharwad District. But it disappeared by the middle of the 20<sup>th</sup> century. It again appeared in the Ranibennur forests in 1971 (Neginhal, 1980). It, however, started dwindling by 1996 (Neginhal, 1997). Thereafter hardly any GIB was sighted in this sanctuary. This unfortunate condition continues even today.

Though the main reason for the disappearance of the Bustard is to be attributed to the man-made degradation of the ecosystem, ecologically unsuitable for the Bustards to thrive, other reasons are also contributing to this local extinction. This paper takes stock of these situations and proposes suitable steps for improving the ecological environs at Ranibennur for re-establishing the G.I.B.

## Material and Methods

I had the opportunity of studying this sanctuary over the last 45 years. My observations are based on my field notes taken and the ocular estimates of the GIBs during my several visits. Many papers of my observations in this respect are also published from time to time.

## The Sanctuary

### Abiotic conditions

This sanctuary was constituted in September 1971 for protection and conservation of the endangered Blackbuck (based on my report in 1970). It has an area of 119 sq. kms and covers Hullatti, Chelgeri and Alalgeri village blocks of the Ranibennur taluka of the Haveri district. The general configuration is flat and undulating with gentle slopes and elevations in the form of mounds. The elevation ranges from 780 m to 985 m. Iron stone and quartz are the main underlying

rocks. The soil is reddish, very poor in fertility and lacks humus. It is eroded and shallow. The ecosystem is surrounded by a number of hamlets, villages and agricultural lands. The crops grown are Jowar, maize, millets, mustard, safflower, cotton, groundnut, chilli and so on. The average rainfall is 440 mm. The sanctuary receives both the Southwest (June-August) and the Northeast (September-October) monsoons, the latter contributes more rainfall. The precipitation, however, is irregular and scanty and famines are common. Arid and drought conditions generally prevail. Water sources dry up in summer and the streams stop flowing by December itself.

The ecosystem once had vast expanses of open and undulating lands, clothed with grasslands and scrub forests. Now it is clothed with tall *Eucalyptus* plantations.

### Biotic conditions

The ecosystem once supported a scrub type forests, which were already in poor and degraded condition in 1924 (Kanitkar, 1924). The flora consisted of *Albizia amara*, *Chloroxylon swietenia*, *Acacia* spp., *Hardwickia binata*, *Ixora parviflora*, *Euphorbia* spp., *Dodonaea viscosa*, *Carissa* spp., *Cassia fistula*, *Cassia auriculata*, *Lantana camara* and Sandalwood. These species were gradually wiped out between 1924 and 1950 due to over extraction, illicit fellings, grazing and forest fires.

From 1958 to 1971 afforestation was carried out by the Karnataka Forest Department by contour trenching and sowing of seeds of indigenous species of *Acacia* spp., Neem, *Hardwickia binata*, Tamarind etc., which were stepped up from 1970 onwards (Nadgouda, 1977) for soil conservation works in the watershed areas of the Tungabhadra River under the TRVP project. But the greatest damage to the habitat was caused by taking up mechanized afforestation from 1972 onwards by planting *Eucalyptus* hybrid plants at close spacing (Torvi, 1975). This mechanized planting with *Eucalyptus* sp. at close spacing drastically changed the open type of habitat required by the Bustards. The vast and expansive grassy open



lands scattered with scrub plants available at the sanctuary were soon covered by the fast growing *Eucalyptus* hybrid over the years, thereby gradually shrinking and eliminating the Bustard habitat. This also affected other species of animals and birds, ecologically evolved for open country environs.

### ***Detrimental effect of Eucalyptus Plantings on the Bustard habitat***

Prior to 1950 Ranibennur was in a degraded condition with no flora left and the wild animals like the Blackbuck (*Antelope cervicapra*), Wolf (*Canis lupus*), Indian Fox (*Vulpes bengalensis*) and birds like The Great Indian Bustard, Chestnutbellied Sandgrouse (*Pterocles exustus*), and Indian Courser (*Cursorius coromandelicus*) were wiped out.

After 1958 with the commencement of afforestation with the indigenous species, rebuilding of the habitat commenced and the endangered Blackbuck was the first to appear in the sanctuary. By 1970 (Neginhal, 1974) the Blackbuck was observed moving in large numbers in this ecosystem and a wolf was sighted in 1973.

But the greatest avifaunal discovery of the 20<sup>th</sup> century was the sighting of the endangered Bustards in this habitat in 1971 (Neginhal, 1980), almost after a century of its presence recorded in the Bombay Gazetteer. Its population increased quite rapidly. By 1974 the bustard population rose to 15 as per my count at various locations during a single morning drive (Neginhal, 1980). It was then a common sight to see the bustards and one could go and see them as if with an appointment on any given day.

Soon they commenced breeding; and I was singularly fortunate to photograph a nest of a bustard with an egg in 1976 (Neginhal, 1976). This perhaps is the first recorded photograph of the bustard in the wild!

From 1990 onwards the population of the GIB started dwindling. In one of my visits in 1996, I could not locate even a single bustard in the sanctuary (Neginhal 1997). The reasons for this deplorable ecological disaster was the luxuriant growth of *Eucalyptus* covering most of the area under an afforestation programme, leaving no space for the bustards, ecologically evolved to survive in drier biotopes. This also affected the Blackbuck, the Wolf, the Indian Fox and the birds like the Indian Courser, the Chestnutbellied Sandgrouse and so on.

Against this discouraging ecological disaster of the ecosystem, a most surprising and welcome finding

awaited me when I again visited the sanctuary in January 1997. A GIB was found nesting in a 55 hectares clearfelled *Eucalyptus* plantation (Neginhal, 1997). This patch of the forest was clearfelled in 1996 by the Forest Department to take up afforestations with local indigenous species, after literally uprooting all the *Eucalyptus* plants. The area was also fenced with trench-mound to prevent grazing by local cattle and sheep (the latter graze in thousands in this area). In addition a watchman was posted to guard the plantation. Indigenous species of *Acacia* spp., *Hardwickia* sp. Neem, *Ficus*, Tamarind were planted in the cleared area. This resulted in clothing the cleared area with grass, studded with bushy growth of indigenous species.

The trench-mound fencing guarded this patch against the grazing of village cattle and sheep and even prevented the local predators like the Wolf, Indian Fox, Jackal and shepherd dogs from entering this area for predating on the bustard and its eggs. Even the cattle and sheep *graziers* could not venture into this closed area.

The Forest Department officials had unwittingly created favourable breeding conditions for the Bustards, which promptly took advantage of the opportunity given to them, to resettle and breed in this cleared area. This area had given the bird proper protection for breeding and also provided necessary shelter and sufficient food in the form of insects, lizards, snakes, and frogs to survive and rear its young.

### ***Results and Discussion***

The Great Indian Bustard and its associate dry-zone biotope animals like the Blackbuck, Wolf and Indian Fox, which were quite common in the 1890s at Ranibennur, had become locally extinct by the 1950s due to destruction of their habitats, non-availability of shelter, food, breeding places and uncontrolled poaching.

From 1958 to 1972 the Forest Department took up afforestation in this *biotope* to rejuvenate the forest flora and for preventing soil erosion for which special staff and funds were provided under the Tungabhadra River Valley Project (TRVP).

Under this project extensive trenching and planting works were taken up by sowing seeds of indigenous species like *Acacia nilotica*, *Acacia catechu*, *Albizia amara*, *Azadirachta indica*, *Hardwickia binata*, Sandalwood, *Cassia fistula*, *Tamarindus indicus* and so on in the trenches and on their mounds.

The plants coming up rejuvenated the biotope, provided essential food in the form of browsing vegetation to the herbivores and insects to the birds, in addition to providing shelter and breeding grounds for these open country endangered animals and birds. So these birds and animals commenced to rehabilitate this ecosystem. As the grazing was stopped and planting sites were protected against the local shepherds and villagers, profuse grass and herbs came up. The constant presence of the Forest Staff to carry out the afforestation works also provided protection against the poachers. This vegetative enrichment of the biotope resulted in increasing the carrying capacity of the habitat for the increasing populations of wild animals and birds. So the adverse biotic factors decreased as the welfare factors increased.

The rejuvenation provided optimum favourable conditions for the Blackbuck to appear first in this biotope in the 1960s. From 1970 onwards herds of Blackbuck were observed moving in the habitat.

The GIB started losing its ground from 1990. The luxurious growth of *Eucalyptus* covering most of the open space habitats of the bustards had pushed these endangered birds to the brink of extinction.

However, the GIB recovered from being entirely wiped out when it found a 55 ha. *Eucalyptus* plantation clearfelled, fenced, planted with indigenous species to breed. This provided optimum environmental conditions for the open country bird like the GIB to recover from its near extinction and to breed in the cleared area in 1997.

So, if the GIB is to be recovered and rehabilitated at the Ranibennur sanctuary, the man made degraded ecosystem has to be brought back to its open country environmental conditions. This can be done by clearing the *Eucalyptus* plantations and clothing the habitats with the indigenous species.

### Recommendations

- i. The GIB is the most endangered bird in the world today. Hardly 400-450 GIBs are found in pockets in Karnataka, Maharashtra, Madhya Pradesh and Rajasthan.
- ii. Ranibennur in Karnataka is one of its breeding grounds since centuries.
- iii. Its habitat has been destroyed over the years by taking up large scale plantations of *Eucalyptus* hybrid in the past.
- iv. Its survival is involved by taking up clearance of these *Eucalyptus* plantations and raising therein indigenous species to provide open country environs, for which the Nature has evolved this and other open country species for habitation.
- v. If the wholesale clearance is not possible and feasible, at least some patches of 100-200 ha. may be cleared, scattered over the whole sanctuary, and raised with indigenous species after providing proper protection and electric fencing.
- vi. The open uncultivable lands available adjoining the sanctuary should be acquired to serve as buffer zone.
- vii. These urgent steps are necessary to save the GIB from its extinction both at the state and national level.
- viii. Like the Tiger and Elephant national Projects, a Great Indian Bustard Project has to be implemented in the country.
- ix. By preserving the GIB, the flagship species, in the eastern plains and the Deccan, the other endangered open country species of birds, wild animals and flora could also be saved from extinction.

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# Status of Great Indian Bustard (*Ardeotis nigriceps*) at Ranebennur Blackbuck Sanctuary

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## Introduction

Great Indian Bustard (*Ardeotis nigriceps*) is a vulture sized bird belonging to family Otididae. It feeds on grains and shoots of various crops, insects, lizards etc and is included under Schedule I Part III of Wildlife Protection Act 1972.

The Great Indian Bustard is classified as Endangered because of its very small, declining population, a result of hunting and agricultural development (Birdlife International, 2000). It has entirely disappeared from five Indian and Pakistani states, and very few birds remain in four other Indian states. Only tiny populations (<100) exist in Andhra Pradesh and Maharashtra, so the last stronghold of the species is in the arid semi-desert of extreme western Rajasthan, India. The largest protected area set aside for this highlight bird is Desert National Park, where its population is estimated at perhaps 500 bustards. Their ecology has been studied here at Ranebennur to some extent, and there are rangers to try to protect the reserve from poaching. International Union for Conservation of Nature (IUCN) has warned that the Great Indian Bustard found across the arid/semi-arid grasslands in India and Pakistan would soon be a thing of the past and will be extinct within a decade if measures are not taken urgently.

According to an estimate the total number of surviving birds presently could be as low as 500. Poaching and deteriorating habitats were the two main causes for drastic decline of the Bustard population. The current status of the Great Indian Bustards at the Ranebennur Blackbuck Sanctuary is quite alarming, as the bird has not been authentically sighted since 2001. There are various factors that lead to the decline of Bustard population at the sanctuary.

## Current Status of Ranebennur Blackbuck Sanctuary

Ranebennur Blackbuck Sanctuary, with an area of 119 sq km is located at Lat 14° 34' 00" to 14° 46' 00" N, Lon 75° 30' 08" to 75° 47' 21" E. The sanctuary was declared in 1974 and was provided more legal status for conservation in the Schedule I protected

ungulate, the Blackbuck. The terrain is mainly of plain land with interspersed hillocks at the periphery. The vegetation is comprises grassland plains and scrub jungles. There is a vast *Eucalyptus* plantation planted 1956 onwards which covers 98% of the sanctuary. In such a vast grassy and shrubby plains, birds like the Great Indian Bustard, Indian Courser, Sandgrouse and mammals like Blackbuck, Wolf, and Jackal coexist. The population of the blackbucks during the last census conducted in 1997 was estimated to be about 5000 individuals (source: Ranebennur Blackbuck Sanctuary, Karnataka Forest Department). Fortunately, the most critically threatened and endangered bird, Great Indian Bustard also existed and this sanctuary proved to be one of the few ideal breeding grounds for these rare birds. There are quite good number of records that proved these birds breeding till 1999. Great Indian Bustards are facing many threats that has lead to the decline of their population drastically.

## Material and Methods

A rapid survey of the entire Blackbuck Sanctuary was conducted to understand the condition of the landscape, habitat, flora and fauna of the area. This facilitated to know more about the movement of the Great Indian Bustard from the past to till date. The possible reason for their decline was understood by interacting with the villagers, bird watchers, forest officials and the like.

1. All the three blocks of the sanctuary, namely, the Hullatti, Hunsekette and the Alalgeri Block were rapidly surveyed along with the topo sheet map to get an over all idea of the study area.
2. The areas at which Great Indian Bustards were sighted previously/bred were visited.
3. Many of the villagers, bird watchers and the forest officials familar to this area or residing since a decade were thoroughly interviewed to get the background reasons possible for the Great Indian Bustards population decline.



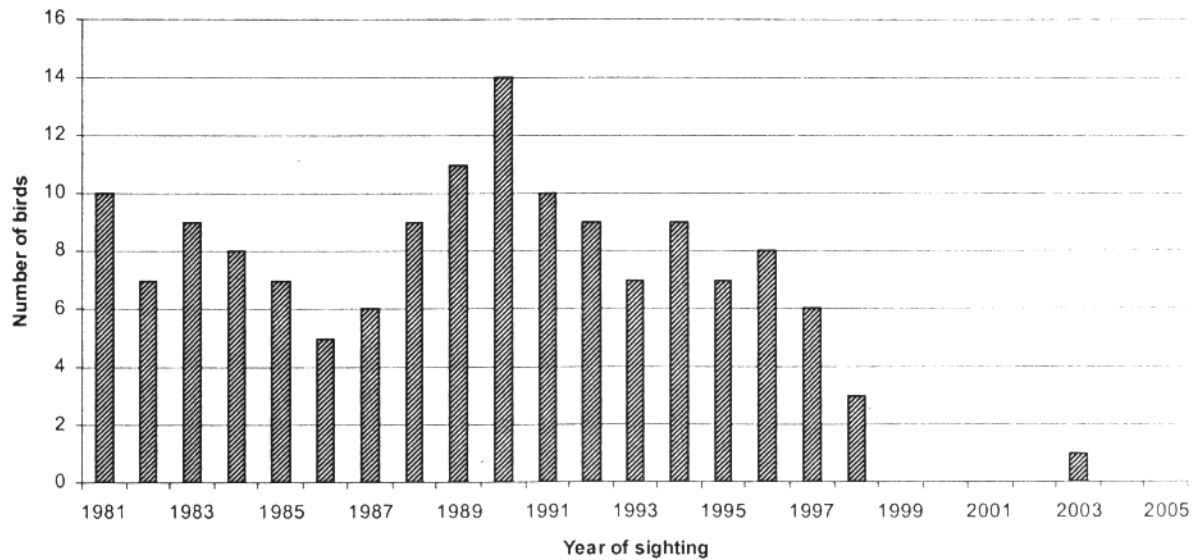


Fig. 1. Great Indian Bustard Sightings

4. The past records that had been maintained till date by the forest department regarding the sighting of the Great Indian Bustards were checked and documented.
5. Two group discussions were conducted for getting the views from different sectors of the peoples such as bird watchers, shepherds, villagers, forest officials etc.
6. A month long survey interviewing the villagers residing around the sanctuary was conducted to understand the causes for the decline of the Great Indian Bustard population since 5 years.

(During all the above steps, care was taken to avoid disturbance to the habitat)

### Results and Discussion

1. The sighting of Great Indian Bustards till date (Fig. 1) reveals that, these birds preferred this location and were residing and breeding till 1998. Later records show that birds were quite disturbed and stopped breeding, but visited the location till 2003. Recent observation by the villagers and forest officials reveals that a pair of Great Indian Bustard had visited and bred this year (2005) too, but got disturbed and did not return to their breeding site abandoning the egg. (not officially recorded).
2. The spot where these birds used to breed and reside earlier are grassland plains. The region in which the birds sighted recently (2003 and 2005) also happens to be a disturbed grassland plain. Comparing the above two benchmark spots, we

can say that the habitat preferred by these birds were grassland plains.

3. Except for very sparse patches, most of the earlier grassland plains have been converted to *Eucalyptus* plantations.
4. The rigorous growth of the *Eucalyptus* plantation has provided good shelter for the wolves and jackals that easily can predate on the eggs, chicks and sometimes the adult Great Indian Bustard (Incidents on record). This is because of the lack of visibility for these birds to escape from the predators due to the *Eucalyptus* growth.
5. The grassland plains have now given way for cultivation with crops like Sunflower, Maize and Horsegrains. These lands also had witnessed the breeding and residing of the Great Indian Bustards till 2003. (Recently, a pair of these birds have arrived to the peripheral area and went away, an egg has been spotted by the villagers – not authenticated)
6. Due to recent planting of *Eucalyptus* and *Prosopis* saplings at some areas at Hullatti block of the Sanctuary and non-trimming of the bushes, the sparse patches of grassland plains is giving rise to bushy vegetation and transforming to scrubby patches, thus depleting the grassland plains (Hullatti block).
7. Sheep grazing has increased substantially in recent years due to subsidy provided by the government. There are quite good proportion of nomadic shepherds who come from Maharashtra once in six months.

8. There were lot of visitors and photographers during the peak breeding and parental care period.
9. Illegal entry by these shepherds for grazing and water has increased due to the increase in sheep number and scarcity of water availability (Few grassland patch and two check dams that store rain water attract these shepherds).

### **Recent Records**

In spite of all these there are two records as per the villagers, the bird had visited the plains at the periphery of the sanctuary, laid an egg, but flew away due to disturbance by the shepherds who comes for culling the bird but missed it and hence collected the egg for consumption (April, 2005); A lady collected two Bustard eggs (after it flew away from incubating and never returned next day) at Medleri block near 7th mile stone (March, 2004) and tried incubating it along with the chicken's eggs but failed.

Looking at all the above instances and the recent findings, it is clear that the Great Indian Bustards preferred grassy plains and they were shifting to the periphery and crop fields as and when fresh Eucalyptus plantations were raised and also when the population of the sheep grazing increased to enormous extent.

It is very important to rejuvenate the transformed landscapes back to the plains that will create the required habitats for the Great Indian Bustards at the already identified hotspots in and around the sanctuary. Villagers, not aware regarding the importance of this bird population and the current trend of decline, had only thought of its meat and egg for consumption. After

much discussions and making them aware about the alarming situations, they are now convinced and have made up their mind to protect these birds and are eagerly waiting for their arrival to provide protection and help them breed further.

### **Acknowledgements**

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# Present Status of Vulture in Mahuva District Bhavnagar, Gujarat

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## Introduction

The vulture decline in the Indian subcontinent is the hot issue of present day. Until 1990 the Oriental White-backed Vulture, *Gyps bengalensis* was the most common and abundant species throughout the Indian subcontinent. But now Oriental White-backed Vulture and other two species; the Long-billed Vulture *Gyps indicus* and the Slender-billed Vulture *Gyps tenuirostris* are facing threat of extinction. The population of Oriental White-backed Vulture has also gone down in Bhavnagar district (Gadhvi I.R. pers.comm.). A sizable population of Oriental White-backed Vulture is still surviving in Mahuva town due to presence of large number of coconut trees (*Cocos nucifera*) and Panjarapole in the area.

Mahuva town (21°. 05' N 71°. 45' E) is located on the coast of Gulf of Khambhat, 100km. southwards from Bhavnagar District head quarter in Gujarat state in the western part of India. Mahuva is famous for its coconut plantations in entire district.

Information about the present status of oriental White backed vulture, its nesting and possible causes of decline in population and recommendation for its conservation is presented.

## Material and Method

The present study was carried out during March 2002 to Aug. 2002, June 2004, March 2005 and May-June 2005. Number of vultures were reported by direct observations from a vehicle, observation were made at the soaring time, roosting time, and at feeding site (Panjarapole dumping site). The nest survey was conducted in March 2005. As it is the nesting season (October-March) for vulture in Saurashtra (Dharmakumar Sinhji, 1955). The nest was observed with the help of binoculars (10x50). 70% area was thoroughly surveyed from the total roosting area. The nest observations were made from the ground to avoid disturbance to nesting bird. Figures of vultures died during last 4-5 months were collected from the RFO office Mahuva, members of Flamingo Nature club Mahuva, forest department staff Mahuva, owners and laborers working in coconut farm were inquired at regular intervals to collect the information about the population, nesting activity, disturbance to

birds, economic loss to owner due to vulture activity etc.

## Results and Discussion

Since 2001, the number of soaring oriental White-backed Vulture was recorded as 35 in Oct. 01, 45 in Nov. 02, 65 in March 03. 101+44 in June 2004. One hundred and fifty White-backed Vulture and 12 long billed vulture in March 2005, 92 White-backed Vulture and 5 Long-billed Vulture in Aug. 2005 were recorded. Total 25 active and 25 deserted nest were found during March 2005. According to RFO office Mahuva 47 (including 3 juvenile) of White-backed Vultures and 2 Long-billed Vulture were found to be dead during March 2005 to Aug. 2005 from Mahuva vulture colony. But according to members of the Flamingo nature club Mahuva the casualties were much more, total 72 vultures (3 LB) died during March 2005 to Aug. 2005. Possible cause for death was visceral gout in one case and starvation & nephritis in other case (PM report).

It was observed that the vultures of Mahuva are facing lots of problems from the owners of coconut tree farms, and in the same way vultures are also nuisance for the farm owners by damaging coconut trees which results in economic loss. Water scarcity during summer months was also observed; scarcity of food near roosting site was also noticed. Carcasses of small animals treated with insecticides are thrown in municipal compost peats.

For the last few years observation of the population of White-backed Vulture was recorded but the detailed survey was made at Mahuva in June 2004 to present the data for workshop on "Current status of vulture in Gujarat" 145+ White-backed Vultures were recorded from around Mahuva town in the coconut farms. The coconut tree is an ideal tree for oriental White-backed Vulture in this area, as the tree is more than 60 ft. tall, with strong leaflets which can bear heavy weight of the vulture, having suitable canopy for roosting & nesting and also having raw materials for nest building. All these good factors favours the population of the oriental White-backed Vulture in a particular area. Vulture population survey done by GEER (Gujarat Ecological Educational & Research)



foundation in Gujarat (May 2005) also support the population of Mahuva (145 OWBV & 3 LBV). The other reason for having good number of vultures in the area is Panjarapole, as there is a well known "Chhapariyali Panjarapole" at Chhapariyali village 30km. away from Mahuva, having more than 3000 cattle, Panjarapole is a good source of carcasses for the vultures of the surrounding area.

25 active nests (approximately 70% area was surveyed) and 25 deserted nests and possibility of more 9-10 nests from unsurveyed area suggest the good number of breeding population individual. In Gujarat 28.4% of the oriental White-back Vulture *Gyps bengalensis* were to be breeding population (status of vulture in Gujarat state 2005), where as in Mahuva 48.27 % of the Oriental White-backed Vulture population is breeding, they suggest that there is still a favorable condition for nesting activity. But during the survey some shocking information was also found about the conflict between human and vultures.

Large scale population decline was observed during March to Aug.05. According to volunteers of Flamingo Nature Club total 72 vultures were dead but the RFO office supports a total 49 death. The Vulture Specialist Group (VSG) has short-listed eight major pathways as the cause of decline of vultures, among them are (1) loss of nesting habitat (2) infectious diseases (3) use of veterinary drugs (4) general environmental contamination (5) low food availability etc. may play role in population decline in the area.

It was observed that mostly, death occurs during summer. During summer the temperature is very high (30°C to 40°C) and water shortage is also noticed at feeding site and roosting site. It was interesting that the vulture was not regularly observed during this period at Chhapariyali Panjarapole dumping site. Vultures might avoid a long feeding flight (30 km. from roosting site) during hot days and remain hungry due to shortage of carcasses in nearby area. In this condition death might occur due to starvation and shortage of water. According to local people mortality observed every year during summer is very high.

Postmortem reports of dead birds suggest the possible cause of death, starvation & nephritis. Visceral gout is another possible cause for death (PM report). Gout has been reported from various animal taxa such as snakes, lizards, crocodile, birds and animals. Presence of red meat in the diet is considered to be a major contributing factor for susceptibility to gout (Arun & Azeez). Possible causes for visceral gout are (1) excess of protein,

nonprotein nitrogen associated with excessive production of uric acid, the vulture being a scavenger species, consumes flesh of dead animals in routine which is a very good source of protein in diet. (2) nephrotoxic agents like excess of calcium in diet, sodium intoxication, vit.A deficiency, infectious causes, toxic chemicals, insecticide, starvation, inclement weather, dehydration etc. (Mishra & Prasad). In study area diclofenac is used in Panjarapole since it came in market. However, death did not occur throughout the year but only in summer season. It suggests that diclofenac is not responsible for the death, although the role of diclofenac residues in the oriental White-backed vulture, mortality from the Indian region is yet to be confirmed experimentally (Arun & Azeez).

The primary survey reveals that the vultures in Mahuva are facing lots of problems which can be summarized as follows.

- ❖ At the time of the coconut harvesting the person who climbs up the tree throws away the nests.
  - ❖ Gives thrust on the stem of the tree with dry leaflet of coconut and forces the birds to go away.
  - ❖ Fire arms and fire crackers are used to keep the vultures away.
  - ❖ Eggs are collected and used as medicine for treating asthma.
  - ❖ Scarcity of food near roosting place is one of the main concerns.
  - ❖ Carcasses of small animals are thrown in a municipal compost peat and the authorities spray pesticides on the carcasses to prevent production of pathogens and spread of diseases.
  - ❖ Scarcity of water both at Chhapariyali Panjarapole dumping site and the roosting site.
  - ❖ Number of coconut farms is decreasing year after year due to shortage of water for irrigation.
- Vulture colony of Mahuva is an unique case in which both vultures and people suffer. The vultures causes economic loss to the coconut farmers as follows:-
- ❖ They break the leaves of coconut tree. Resulting in retarded growth of the tree.
  - ❖ Due to incessant nesting activities large number of unripe coconuts fall to the ground.
  - ❖ Laborers get injured whenever unripe coconuts fall on them due to the activities of the vultures.

- \* Vulture droppings not only dirty the trees, but also renders the entire area foul smelling.
- \* The tree which is utilized for nesting for several years dies prematurely.
- \* Whenever an egg falls from the nest, the entire area smells awful. Cattle refuse to eat grass contaminated with vulture droppings.

Conservation of any species is impossible without the involvement of local community. To conserve the Oriental White-backed Vulture in Mahuva the following conservation measures are recommended :

#### **Conservation measures recommended**

- \* Farmers and local people should be motivated on the religious point of view that the Jatayu in Ramayana was an ancestor of these vultures.
  - \* The owner of the coconut farm suffers an average loss of Rs.500/- per coconut tree per year. They must be compensated for their losses.
  - \* The compensation should be determined according to the number of chicks fledged per nest.
  - \* The nesting trees should be monitored regularly during the nesting season.
  - \* Local NGO/NGI and Forest Department staff should actively participate in the vulture conservation programmes.
  - \* Forest Department should establish some feeding station especially in summer season (April to July) at Gujarat Agriculture University Research Center, Mahuva, locally known 'Plantation' which is ideal for feeding the vultures.
  - \* Carcasses for feeding station should be obtained from Panjarapole, municipal authority etc.
  - \* Feeding station should be facilitated with water by erecting readymade synthetic or cement water tanks.
  - \* Spraying of pesticide should be minimised by the municipality.
  - \* Carcasses should be dumped separately and should not be mixed with other solid wastes at the compost peat.
- \* Efforts should be made to replace the drug diclofenac with an alternative drug.

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# Avifaunal Diversity in Different Vegetation Types of Central Western Ghats, India

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## Introduction

Avian community studies provide effective tools for monitoring a forest ecosystem. Evaluating bird communities of the Western Ghats to plan for biodiversity-friendly development is gaining significance (Pramod *et al.*, 1997). Ali and Ripley (1983) reported the avifauna of Indian subcontinent being represented by 2,094 forms belonging to 1,200 species of which 19.9% (417) forms are wetland birds (Rao *et al.*, 1997). In recent years, importance of bird diversity and its conservation has been emphasized and such studies are encouraged. Much work related to the avifaunal diversity has been done in temperate forests, while, a very limited data is available in the tropics (Karr, 1982; Ripley, 1978).

The Western and Eastern Ghats of India harboring a fairly rich faunal and floral wealth are relatively unexplored. Only a few reports are available pertaining to the Western Ghats (Daniel *et al.*, 1992). Not many studies have been made in the region of Coorg district of Karnataka. Betts (1930, 1932, 1934 and 1938) in a series of articles copiously recorded several aspects of bird life in the Coorg (presently Kodagu) district. Bhagwat (2002) examined the effects of landscape modification on bird diversity in Kodagu district. Other reports (Chakravarthy and Tejasvi, 1992; Senani, 2000) related to survey of birds was also carried out in Kodagu district and the adjoining Rajeev Gandhi National Park, Nagarhole and no serious studies exclusively on bird diversity across different landscapes are made in the Virajpet Taluk region of Kodagu district. From the review of the above literature, it was inferred that not much studies are made in this region (Kodagu district) and that studies on census, diversity and relationship with the vegetation is wanting. Hence, the present study was attempted on the birds of natural forest including sacred groves and coffee plantations in Virajpet taluk of Kodagu district in Karnataka, a part of the Western Ghats.

## Study Area

The study was carried out under different habitat structures of Virajpet taluk in Kodagu district of Karnataka. Kodagu district, located in the Western Ghats (75° 25' - 76° 14' E and 12° 15' - 12° 45' N) shares a common border with Kerala in the South, and is surrounded by three other districts of Karnataka namely, Dakshina Kannada, Hassan and Mysore. The eastern border of Kodagu district extends over the Mysore plateau. The elevation ranges between 850 m and 1745 m, and the highest points being at the extreme western part of Kodagu, a natural barrier between Kodagu and the coastal lowlands of Karnataka. The study area lying at 12° 19' N and 75° 79' E had 12 sites covering 6 habitats namely, Nagarhole, Makutta, Manchalli, Kanoor, Hudikeri, Ponnampet, Pollibetta, Ammathi, Siddapur, Kolthod-Bygodu, Kadhanoor and Mythadi of Virajpet taluk. 6 different bird habitats were recognized as Wet-Evergreen Forest, Semi-evergreen Forest, Moist Deciduous Forest, Dry Deciduous Forest, Sacred Groves and Coffee Plantation.

## Material and Methods

Under this study, the birds were sampled by line transect method. A transect of 200m was chosen in different vegetation types namely Natural Forests, Sacred Groves and Coffee plantations to census birds for half an hour. The bird numbers on either side of the transect while on a walk of constant slow speed along the transect were recorded. Sampling began at 7:00 AM and continued upto 9:00 AM and in the evening, bird sampling was done from 4:00 PM to 6:00 PM. In each habitat, minimum of 8 censuses were conducted. About four to eight censuses were carried out per month in each study site. At each study site, all the birds that were seen were recorded by species with field binoculars (8 x 30 and 10 x 50) and census was not conducted on rainy and heavy misty mornings. All birds that were heard while sampling were not counted because of the lack of information on the identity of species by bird call

alone. The species identification was based on Ali (1996) and the nomenclature was based on Grimmett *et al.* (1999).

### **Analytical Method**

#### *Mean number of species and individuals per census*

There were 8 transects in each of the forest types namely Wet-evergreen, Semi-evergreen, Moist deciduous, Dry deciduous, 24 transects in Sacred Groves and 56 transects in Coffee plantations. The number of species and individuals over all the transects for each of the habitat was calculated. The mean number of species and individuals per transect was then computed for each habitat separately. Since, the number of transects studied was not uniform in all the habitats, mean of all the indices transect was computed and normalised. This eliminated the error due to unequal sampling among habitats. The mean indices across different habitats were compared to get estimates of bird diversity in each habitat.

### **Species Diversity Index**

The bird species diversity in each of the study areas was calculated using the Shannon-Weiner Diversity Index ( $H'$ ). (Krebs, 1972)

$$H' = - \sum_{i=1}^s p_i \log p_i$$

where,

$s$  = the number of species

$p_i$  = the proportion of a particular species in a sample which is multiplied by the natural logarithm of itself.

### **Species Richness Index**

The number of species present is the species richness, which is a simple index of diversity whereas, the other index such as Shannon-Weiner Index takes into account how evenly the total number of individuals in a sample is apportioned between each species (equitability).

### **Similarity Index**

To discuss the compositional similarity between the habitats, Jaccard's (1908) index of similarity ( $J$ ) was applied. The similarity index refers to the ratio of number of species shared to total species numbers among the various entities compared.

$$\text{i.e., } J = N_c / N_1 + N_2 - N_c$$

where,

$N_c$  is the number of species in common,

$N_1$  is the number of species in first entity,

$N_2$  is the number of species in second entity.

## **Results and Discussion**

### **Species Richness**

The total number of bird species supported by the various types of habitat corresponded with the complexity of the vegetation as inferred from the respective number of species per transect namely,  $28.62 \pm 3.20$  (W-evg.),  $23.00 \pm 1.69$  (S-evg.),  $23.75 \pm 2.06$  (MDF),  $23.00 \pm 2.26$  (DDF),  $23.29 \pm 3.53$  (S.G.) and  $22.25 \pm 2.96$  (C). Hence, the species richness value in the study area varied from  $22.25 \pm 2.96$  (C) to  $28.62$  (W-evg.) in the six habitats studied. The maximum value was recorded for the Wet-evergreen forests (28.62). The coffee plantation showed comparatively lower values. More species with high number of individuals were also found in the Wet-evergreen forests.

Considering each habitat separately, the vegetation structure is complex and diversified in Wet-evergreens (Ramesh and Pascal, 1997). The higher bird species richness here might be due to the richness of food resources in the forests with complex vegetation.

This in turn comprises of varied kinds of microhabitats supporting different categories of birds to thrive here (Rathinasabapathy and Asokan, 1993). James and Wamer (1982) while studying the community diversity in tropical bird communities of Central Panama had suggested that the species richness was related to the vegetation structure. Further, the species richness in an area is dependent on the availability of food, climate, evolutionary history and predation pressure.

The nectarivorous, frugivorous and insectivorous birds were abundant in Wet- evergreen forest which inturn indicates the presence of diverse nectar and fruit yielding plants. These plants in turn support abundant variety of insects, thereby attracting the insectivorous birds. Thus all these birds contribute for bird species richness in this forest.

### **Bird Species Diversity**

The Shannon's diversity index was calculated for each of the habitats. In the present study, the diversity values ( $H'$ ) were found to be higher in forested areas than in plantation areas. Under this study, The Wet-evergreen forest was associated with higher values of Shannon's diversity index compared to other habitats as per the results obtained. The Shannon diversity index was the highest in Wet-evergreen forest ( $3.30 \pm 0.12$ ) followed by Semi-evergreen forest ( $3.02 \pm 0.07$ ), Sacred groves ( $3.02 \pm 0.14$ ) and Moist



deciduous forests ( $3.00 \pm 0.09$ ). But Dry deciduous forest ( $2.96 \pm 0.13$ ) and Coffee plantations ( $2.96 \pm 0.11$ ) had lower bird species diversity comparatively. The more complex the vegetation, the more complex will be the bird community. Bucher *et al.*, (1987) also observed a higher bird species diversity in forested areas namely patch ravine forest and tropical moist deciduous hill forest than in the plantation areas, namely coffee and teak. In another study by Rathinasabapathy and Asokan (1993) in different vegetation types of Eastern Ghat in Andhra Pradesh, the bird diversity was more in forested areas than in plantation areas. They argued that bird species diversity was a function of complexity of the vegetation.

Habitat heterogeneity in addition to area including habitat factors such as tree density, basal area, and number of tree species, percent ground cover, percent canopy cover and canopy height are also important in determining species richness and diversity (Jayson and Mathew, 2000). These factors create different kinds of microhabitats especially for birds and insects. The microhabitats were diverse in wet-evergreen forest under the study area. Thus habitat heterogeneity may be one of the factors causing the higher diversity recorded, since, the complexity of the vegetation structure influences abundance of the bird species. The difference in the bird species composition is due to the differences in the microhabitat among the sites. Further, the reason for the poor bird species composition in the plantation is due to the simple structure and dominant monoculture make-up of the plantation. Similar observations were made by Buchler *et al.* (1987).

Frequent disturbances can prevent bird communities from establishing in any vegetation type. 'Establishing' need not necessarily mean "to breed". A species finding sufficient food in any habitat eventually becomes dependent on it. For example, a lot of forest birds such as Greater Racket-tailed, Haircrested and Bronzed Drongos, Lorikeets, Plum-headed Parakeets and Hill Mynas visit the flowering trees for nectar. Nectar is an important source of sugar for a lot of otherwise insectivorous birds (Ali and Ripley, 1983). The human activity in the coffee plantations is also more and a regular phenomenon compared to forested habitats which certainly affect the establishment of the bird communities. The lower species diversity in the plantation may be attributed to this fact also. It is the evergreens which have suffered less from conversion to plantations than the

deciduous in Kodagu district as found out by Ramakrishnan *et al.* (2000). Hence considering these observations, fewer disturbances to the bird habitats in the evergreens eventually supporting higher bird diversity can be expected.

While comparing the entire forest ecosystem with that of coffee ecosystem, the bird species diversity is again more towards the forest habitats than the coffee plantation. There are many reasons to support this observation. The foremost thing is the complex diversity of plant species in forests that can support a greater diversity of birds than plantations which are often monocultures dominated by single plant species. Another important factor to be observed in both forest and the coffee ecosystem is the impact of the higher frequency of synchronous flowering pattern found in the plantations (due to the dominant monoculture) as against the very random and non-synchronous flowering of the forest ecosystem as a whole. Thus, the forest ecosystem can support more number of nectarivorous and pollen feeding birds in addition to other categories of bird species almost throughout the year and hence the diversity may be more in a forest ecosystem especially during the season of non-flowering in coffee plants.

Forest with the greatest variety of growth stages provides more habitats for birds and hence supports more species than uniform woods (Fuller, 1995). This is very much reflected by the complex stratification found in the Evergreen forest than other habitat types. The tree species in a coffee plantation go through more or less regular cycles of pruning, cutting and regrowth due to the human intervention, which might disturb the bird population. Whereas, in case of natural forest, human interference is less and hence, less or no disturbance to the bird population.

A widespread pattern in nature is that more species live in larger patches of habitat. This applies to many groups of organisms including birds in woodland. The present study clearly indicated that wet-evergreens which are under larger and wider patch support a higher diversity of birds than other forest types. This pattern also holds good for comparing entire forest area and coffee plantations. Many studies by Fuller (1987) and Hinsley *et al.*, (1992) show that large woods support more species than small woods. Fuller (1982) suggested that the bird species composition can also vary with woodland area. The species that avoid woodland edges are more likely to be accommodated within larger groves, thus theoretically contributing to the higher species richness in larger

woods than small wood (Fuller, 1995). This difference is clearly indicated under the present study in a comparison between Wet-evergreen and other forest types.

The birds respond strongly to many attributes of woods, other than area. Indeed, where birds are related to an area, it may be indirectly through factors such as edge effects. On the other hand, in contrast to the number of species, the overall density of birds appear to be lower in large woods than in small woods with similar vegetation composition. This effect probably arises because small woodland patches have relatively large amounts of edge habitat, which often carry higher densities of birds than interior woodland. This can be clearly observed under the present study comparing the bird densities in sacred groves and semi-evergreen patches. Since, the sacred groves in the study area were mostly composed of semi-evergreen trees, the comparison is against a similar kind of habitat composition namely Semi-evergreen forest. This comparison clearly indicates that sacred groves being a smaller wood lot (Kushalappa and Kushalappa, 1996) but having more edge effect than the larger semi-evergreen patch is much richer in bird densities comparatively. Similar observations were made by Ford (1987).

Further, the location and the distance of the coffee plantations from the large forest area may also play a role in explaining the bird diversity. This means to say that the nearer the plantation to the forest area, more will be the species richness as these species may be seen foraging inside plantations from the adjoining thick forest patches which are the primary habitats for these birds. In this context, since most of the study sites under coffee and the sacred groves were located far away from the forest area, lower species richness and diversity in coffee plantations compared to other forest types was observed. Increasingly isolated patches have lower bird diversity because the distances of patches from the large forest may affect the frequency of movement of birds and certain species may not be able to reach the isolated patches. As a consequence, the available variety of resources for birds will decline with distance of a patch from the forest reserve. In response to this, birds that are able to use a wide range of resources will increase in abundance while those that are selective are likely to decline which is quite evident when one looks at the greater proportion of omnivores in coffee plantations as found out in the present study. Similar kind of observations was also recorded by Bhagwat (2002).

Similarity index and proportion of species shared among different habitats

The maximum similarity index of birds was observed between the Coffee plantation and the Sacred Groves at 0.88. i.e., these two habitats were similar in the composition of bird communities at 88% level. Out of the 142 species recorded in these two habitats, 103 species were common to both the habitats. The reason may be due to location of the Sacred Groves being adjoining to the Coffee plantation especially under the study area, due to which frequency of bird movements between these two habitats become a regular and indeed a natural phenomenon indicating that these common species has adapted to exploit the resources available in both the habitats.

The Moist Deciduous Forest was also found to be similar to other habitats such as Dry Deciduous Forest, Sacred Groves and Coffee Plantation in composition of bird communities at 80% level. About 82% similarity in bird composition was also found in Sacred Groves, Semi-evergreen forest and Coffee plantations.

While comparing the entire forest ecosystem as a whole and the coffee ecosystem, it was observed that there was a maximum similarity in bird composition between the two ecosystems. This indicates that coffee plantations were capable of supporting the foraging of a high percentage of forest avifauna i.e., approx. 80%. This included species such as the Grey Jungle fowl, Vernal Hanging Parrot (Lorikeet), Hill Myna, Chestnut-tailed starling, and the Little Spider hunter. However, these species could have been seen foraging inside plantations only because the latter were located close to thick forest patches, which are the primary habitat for these birds and probably the patchiness of the landscape may also have a role here. Bhagwat (2002) also found out that similarity in bird species composition between Sacred Groves and the Forest reserve decreased with the distance of patches from the reserve. Some species were habitually confined to Wet-evergreen, Semi-evergreen, Moist deciduous, Dry deciduous, Sacred groves such as the Large Cuckoo Shrike, Indian Scimitar Babbler, Dark-fronted Babbler, White-bellied Blue Flycatcher, Black & Orange flycatcher. These species were conspicuous by its absence from plantations, may be due to lack of leaf litter and dense herbage, which it needs for its foraging. These observations highlight the importance of the forest habitats as a refuge for this forest. Avifauna as a colonising source and

primary habitat. Similar observations were also recorded by Shahabuddin (1997). Overall, the similarity index in the present study varied from 0.45 to 0.88 i.e., (45% to 88%) (Table 1).

### Conclusion

It appears from this study that the natural forests and the later introduced plantations fall closer in terms of similarity in their bird communities. These plantations are able to mature/stabilise to support levels of bird species diversity close to their vegetation zone. Overall, the study shows that even small and medium-sized forest fragments hold significant populations of bird species including endemics. Small-scale human pressures such as fire wood, fodder and timber extractions and grazing, do bring about subtle changes in available habitats for birds. It appears that birds represent habitat not only by disturbance level but resource availability is another important factor for maintenance which needs to be kept in mind for bird conservation initiatives. Human pressure results in changes in vegetation structure and composition. The high human pressure may lead to greater patch formation and edge extension in the long run, which has more impact on birds. To maintain the bird community, further degradation of the habitat has to be minimized by regulating human activities. Extensive and long-term studies are also necessary to evaluate the

importance of site fidelity in obscuring effects in the short term and to describe the persistence of the effect.

Further, as the birds are influenced by habitat characteristics, rather than merely the area of the fragments, managing habitats through protection and restoration will significantly aid in bird conservation in the region.

Kodagu, the patchy but tree-covered landscape has a potential for protecting bird diversity, predominantly because of the high proportion of native tree-cover that is retained and provides a matrix, which does not inhibit movement of birds. But the recent trend of replacing native trees with exotics such as Silver oak (*Grevilia robusta*) in Kodagu is alarming. In order to protect the present bird diversity, it is crucial to retain as many native shade trees in coffee plantations as possible. Hence, conservation of bird diversity in Kodagu will require the maintenance of native tree-cover (rather than exotic) in coffee plantations, protection and conservation of forest reserve, Sacred forest patches and Wetlands especially for the species of birds vulnerable to extinction, viz. Nilgiri Wood Pigeon, Malabar Pied Hornbill, White-backed Vulture.

The study however, does indicate that coffee plantations can be an important buffer between natural

**Table 1: Similarity index and proportion of species shared among different habitats**

| Â – DIVERSITY | W-evg. | S-evg.      | MDF         | DDF         | SG          | Coffee |
|---------------|--------|-------------|-------------|-------------|-------------|--------|
| W-evg.        | 1      |             |             |             |             |        |
| S-evg.        | 0.62   | 1           |             |             |             |        |
| MDF           | 0.57   | <b>0.76</b> | 1           |             |             |        |
| DDF           | 0.45   | <b>0.72</b> | <b>0.84</b> | 1           |             |        |
| SG            | 0.61   | <b>0.82</b> | <b>0.82</b> | <b>0.70</b> | 1           |        |
| Coffee        | 0.55   | <b>0.82</b> | <b>0.82</b> | 0.68        | <b>0.88</b> | 1      |

### Abbreviations

W-evg = Wet Evergreen Forest type  
S-evg = Semi Evergreen Forest type  
MDF = Moist Deciduous Forest type

DDF = Dry Deciduous Forest type  
SG = Sacred Groves  
Coffee = Coffee plantation

forest habitat patches with high potential for serving as marginal habitat for some species, a dispersal corridor between patches and even a breeding/permanent habitat for some species. The richer they would be in terms of structure the better, these conservation function could be served. This study has also shown that by just looking at species diversity of birds, we may not be able to visualise the real change in bird communities due to changes in vegetation. Characterising birds as typical and atypical to any region is a very useful exercise in identifying localities for conservation of birds.

Ideas for future research in Avifauna as a conservation tool:

1. A useful investigation of species response to the landscape modification in the long term is necessary.
2. Rarity is an important determinant of vulnerability of a bird species to habitat fragmentation. Due to the limitations of the present data set, it was not possible to analyze the patterns of distribution of rare species in the patchy landscape. The future studies on bird diversity in Kodagu should focus on such species.

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# Birds of Bandipur National Park, Survey Report 2002-2003

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## Introduction

Looking at the broader spectrum of conservation and management of National Parks, Wildlife Sanctuaries and Indian wildlife in general, birds are among the least considered.

Today 13% of world birds have been recorded in India including 141 endemic to the country, the richness in species contributed by varied climate, geographical position coupled with rich vegetation and the overlap of three bio-geographical areas, Viz. Palearctic, Indo-Malayan and Afro-tropical. Identifying, cataloging and compiling of bird data is in practice since the British days, which has helped in prompt management of sites required for wildlife and natural history.

Birds as bio-indicators subsequently have proven in identifying the rich bio-diversity of particular site, as primary indicators, they have even substantiated the degradation by their disappearance.

Bandipur being situated enroute to Mysore-Ooty Road was declared a National Park and brought under Project Tiger in 1973. The park is one of the richest wildlife areas in India, a part of the Nilgiri biosphere reserve and considered a major hotspot in the Western Ghats. Bandipur National Park is flanked by Rajeev Gandhi National Park to Northwest, Mudumalai Wildlife Sanctuary to the South and Wynaad Wildlife Sanctuary to Southwest and is quite famous for its big mammals and unique diversity.

## Location of Bandipur National Park

11° 35' 34" N, 76° 12' 17" E, 11° 57' 02" N, 76° 51' 32" E

Total Area: 880 Sq. Kms.

Total Ranges : 09

## Vegetation

Five different vegetation types that are primarily found in Bandipur National Park were selected, looking into the importance of data collection for the bird survey.

### 1. The southern tropical moist deciduous type:

The west parts of Begur, Ainur marigudi and Beerambadi constitute the typical moist deciduous type covering *Bambusa arundinacea* and species of

top canopy are *Tectona grandis*, *Lagerstroemia lanceolata*, *Terminalia tomentosa*, *Terminalia belerica*, *Dalbergia latifolia*, *Anogiesus latifolia*, *Stereospermum xylocarpum*, *Schleichera oleosa*, *Albizia odoratissima*, *Odina wodier*, *Ficus infectoria* and *Ficus* spp. The lower canopy consists of *Emblia officinalis*, *Mallotus philippinensis*, *Kydia calycina*, *Butea monosperma*, *Zyzyphus xylocarpus*, *Vagueria spinosa*, *Grewia tiliaefolia*, *Gmelina arborea*, *Bridelia retusa*, *Bauhinia racemosa*, *Cassia fistula*, *Cordia myxa*, *Randia dumetorum*. etc.

The under growth consists mainly of *Kydia calycina*, *Solanum ferox* and *Solanum indicum*, *Helicteris isora*, *Hemidesmus indicus*, *Holarhena antidysenterica*, *Lantana camara*, *Eupatorium*, *Desmodium* sp., *Flemingia* spp, *Vernonia* spp, *Grewia hirsuta*, etc.

Tall grass like *Andropogon serratus*, *Imperata arundenacea*. Climbers like *Acacia caesia*, *Acacia concinna*, *Asparagus racemosus*, *Clematis* sp, *Entada scandens*, *Jasminum*, *Calycopteris floribunda*, *Ventilago* sp, *Smilax* sp, *Vitis* sp, etc.

### 2. The Southern tropical dry deciduous type:

The central area covers the above type with poor growth of vegetation and open canopy predominantly *Anogeissus latifolia*, *Tectona grandis*, *Terminalia tomentosa*, *T. belerica*, *T. chebula*, *T. paniculata*, *Pterocarpus marsupium*, *Dalbergia latifolia*, *Grewia tiliaefolia*, *Salmalia malabarica*, *Gmelina arborea*, *Dalbergia paniculata*, *Albizia odoratissima*, *Careya arborea*, *Schleichera trijuga*, *Odina wodier*, *Stereospermum chelonoides*, *S. xylocarpum*, *Schrebera sqieteniodes*, *Butea monosperma*, *Emblia officinalis*, *Lagerstroemia parviflora*, *Gardenia* sp.

The secondary canopy consists of *Vanguria spinosa*, *Randia dumetorum*, *Randia uliginosa*, *Wrightia tinctora*, *Zyzyphus jujuba*, *Z. xylocarpus*, *Santalum album*, *Kydia calycina*, *Bridelia retusa*, *Shorea talura* and *Cassia fistula*.

The under growth covered mostly with grasses and *Lantana* bushes breaking with *Eupatorium*, *Phoenix humilis* has come up in-between this.

**3. Scrub Jungle :** Mainly confined to eastern most part of Moyar with poor rainfall, stunted tree growth, rising on shallow hard soil with almost no humus and open canopy, usually the vegetation comprises of *Terminalia chebula*, *Shorea talura*, *Santalum album*, *Anogeissus latifolia*, *Azadirachta indica*, *Acacia leucophloea*, *Acacia catechu*, *Zizyphus sps*, *Diospyros montana*, *Diospyros melanoxylon*, *Diospyros montana*, etc. *Lantana* bushes cover large areas and *Phoenix acaulis*, *Cassia tora*, *Cassia auriculata*, *Desmodium* that usually form the undergrowth. *Acacia intsia* is the common climber, grass is generally abundant.

**4. Riverine:** Nugu river or Moolehole as it is called while flowing inside the park area and Kabini river backwaters are the two major riverine area considered for the bird survey.

**5. Grassy hills:** Gopalaswamy hills were selected for the survey as one of the Important grass hills present covering shola type of forest within the hill range.

### Climate

November to mid February the cold season vale the forest and trees look leafless, the hot season continuous from mid February to mid June. Wet

season starts with monsoon showers from June to September.

The hottest days experienced during March and April, and the coldest being February. A moderate mean annual temperature of the park being 24°C with maximum 30°C and minimum of 18°C. Usually it is foggy during winter and rainy season is experienced at Gopalswamy hills, Bandipur and Moolehole areas. The southwest monsoon effects from mid June upto September with an average rainfall of 1270mm – Kalkere, Ainoormarigudi and Bandipur sharing evenly. The western parts bordering Kerala receive the highest rainfall and the lowest being Moyar.

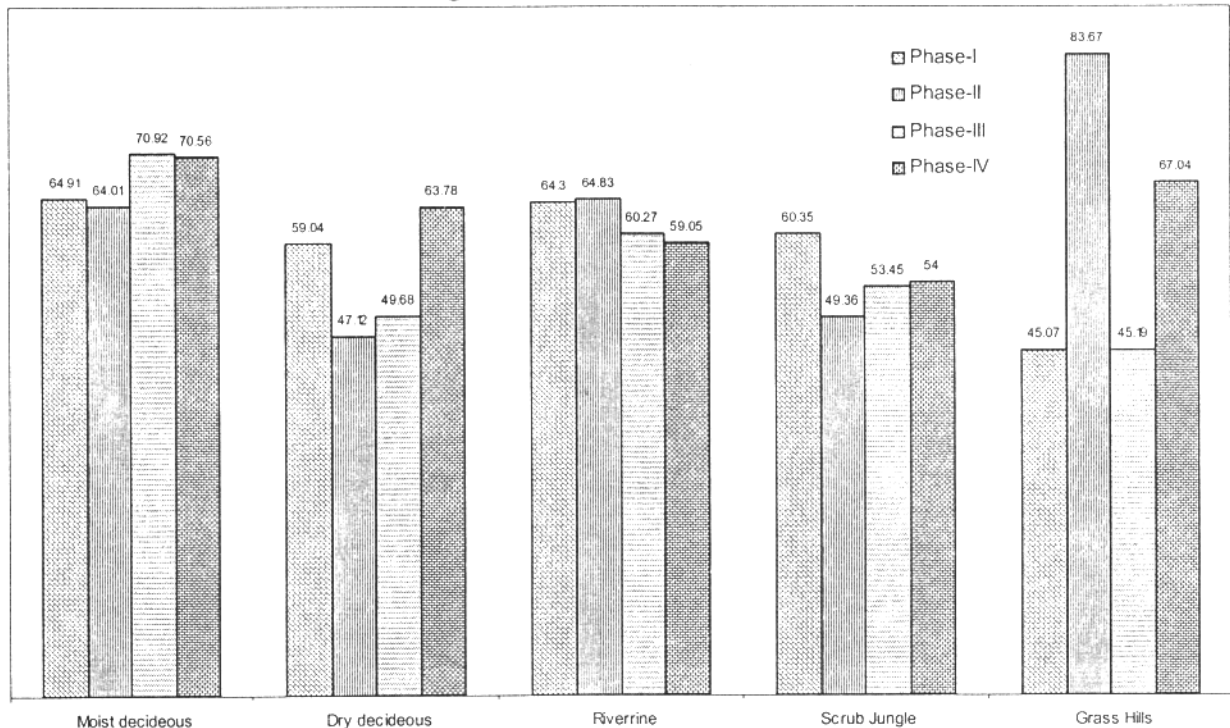
### Altitude

The highest peak in Bandipur range being Gopalswamy hills ranging 1454 Mtrs. The lowest altitude is along Varanchi stream, and Bandipur stands at 995.8 mtrs.

### Water sources

Numerous artificial ponds pocket the National Park with perennial rivers like Nugu river (Moolehole) and its tributaries Hebballa, Varanchi and Chippanahalla flowing northwards join hands. The Kabini river backwaters and its tributaries like Kannegala hole and Paladakadu in the Northwest part of the park constitute major water bodies.

Percentage Distribution of Insectivorous Birds



## Geological

### Rock and soil

Terming the predominant rock as metamorphic out of which Gneiss, Quartzite, Mica, Hornblende and Schists seem the general covers of rock formation in the park, though Igneous rocks, Granite and charconite are equally found. The Southeast part blends a composition of Quartz and pinkish Grey granite.

### Soil

Black clayey soil generally deep, and mixed with nodular limestone, in the undulating ground dominate most areas. Grey or red sandy loam on slopes and other well-drained areas, soil at hilltops and deep valleys are moreover shallow.

### Previous Avifaunal Studies

The rich bird life of Bandipur National Park had attracted Dr. Salim Ali during 1939, around 134 species was recorded from 15<sup>th</sup> to 26<sup>th</sup> November 1939. In the Management plan prepared by the Karnataka Forest Department recorded 179 bird

species in Bandipur National Park during 1974. The Wildlife department Kabini river lodge- Karapur, Mysore Dist. has recorded 274 species. Krupakar & Senani recorded 225 species during 1977.

Dr. Ameen Ahmed and K. Yekantappa, IFS. Recorded 104 species as part of their survey on birds in Bandipur National Park during 1998 and a compiled list of all these was prepared.

### Bird Survey 2002 – 2003

First phase of the Bird survey was conducted from 18th to 21st April. It was also decided by the Field Director, Project Tiger that 4 bird surveys should be conducted during a period of one year to consolidate data for analysis and comparison.

### Survey Dates

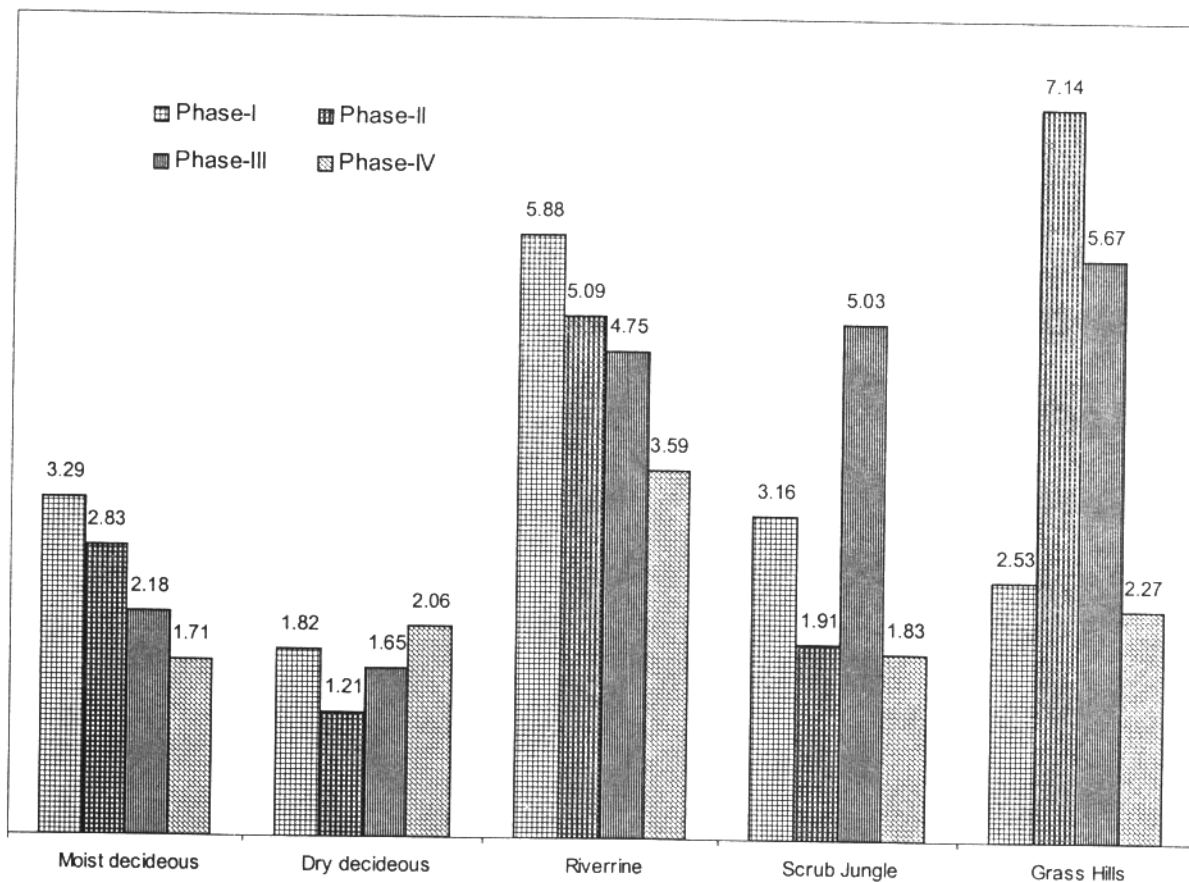
1st phase survey dates : 23<sup>rd</sup> to 27<sup>th</sup> April, 2002.

2<sup>nd</sup> Phase survey dates : 23<sup>rd</sup> to 27<sup>th</sup> October, 2002.

3<sup>rd</sup> phase survey dates : 1<sup>st</sup> to 4<sup>th</sup> February, 2002.

4<sup>th</sup> phase survey dates : 30<sup>th</sup> April to 3<sup>rd</sup> May, 2003.

### Percentage Distribution of Birds of Prey





## Study Sites

Gopalaswamy Hills, Dananda dari Camp., Aladamarada Kolachi Camp., Soole Katte, Awarepurada thota, Mavinahalla Camp., Yeramavu, Kadabana Katte, Naihalla, Devaramadu, Bandipur, Chammanahalla, Banoor Camp., Kalkere, Kullana Betta, Moolehole, Dhanahatti, Chowdalli, Hulikatte, Gundre camp., Varanchi, Alsoor gadde, Hidgalpanchi, Doddahalla, Mavinkallu, Oralkallare, Boodanabetta, Chigarekaduvina halla.

## Material and Methods

- \* The current knowledge of birds available on Bandipur National Park is more of a checklist, which was taken as the base for this survey. A 2-day survey was conducted selecting sites, which encompassed the major vegetation type present in the park.
- \* The complete exercise of this bird survey was area specific to find an **index of bird population density**.
- \* **Area search method** was exercised which accords easy comparison of results from different vegetation, in four phases covering one year.
- \* During the surveys, data was collected species wise and their number at 15-minute interval for 2 hours during morning and 2 hours in the evening.

- \* Total number of birds and species were noted on a standard data sheet, hence time spent was fixed, distance covered was not standardized
- \* Field notes were made about activities like feeding, roosting, courtship, foraging, territorial display and breeding etc.
- \* Sites were covered by walking in a slow pace. Boat was used to cover riverine site.

## Bird Groups

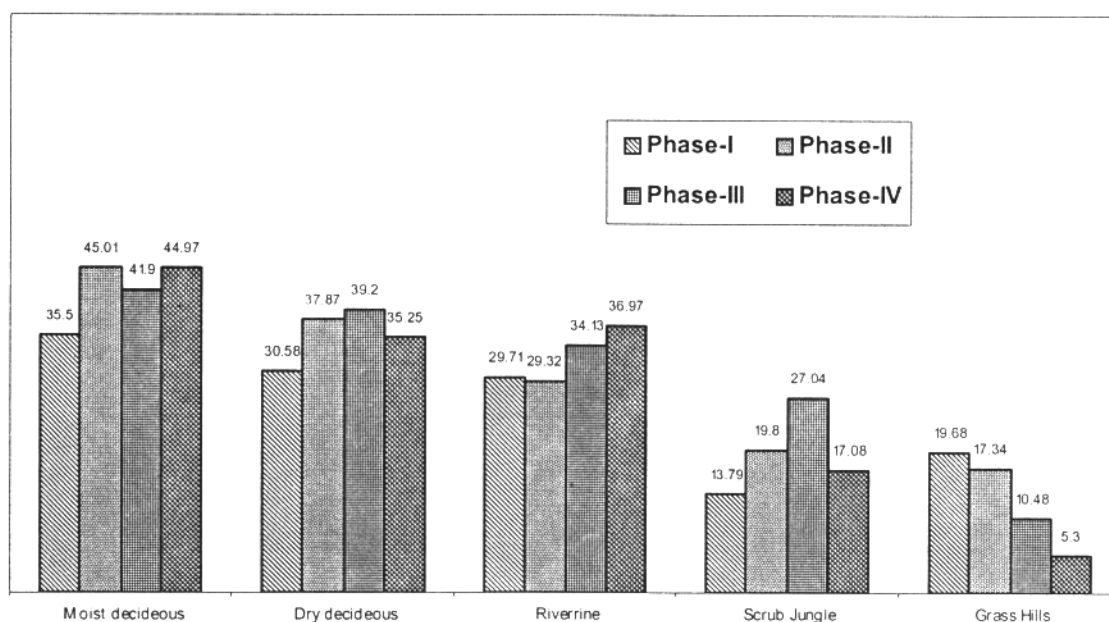
Specific bird groups were determined to incorporate bird groups with relative diet and natural selection of vegetation type for survival. These bird groups as indicators determine habitat preference, eventually for better management of the park.

**A. Insectivorous birds:** Devouring at least 50% and above insects as their regular diet was recorded in this group.

**B. Hole nesters:** As they are one of the important group of birds using tree holes to nest or roost, either drilling holes like the Woodpeckers or using natural tree crevices and snags like Mynas, Parakeets and Hornbills.

**C. Birds of Prey:** Birds, which devour flesh, and other birds, animals as part of their regular diet.

**Percentage Distribution of Hole nesting Birds**



## Appendices

1. **Checklist of Birds** comprises list of recorded birds during the 4 bird surveys.

### 1a. Status

**BrR** : Breeding and resident Birds recorded during the survey where in the observer has recorded nest or nesting activity of the bird.

**R** : Resident birds found round the year.

**Lm** : Local migrant.

**Rr** : Rare visitor to Bandipur National Park.

**Wv** : Winter visitor : Refers to those birds which visit the park during Winter and migrate back after wintering.

**Vg** : Vagrant either locally or a visitor.

**?** : Needs further confirmation.

**N. A** : Information not available.

### 1b. Wildlife Act

**S-I, IV** : This information states that the bird is protected under Wildlife Protection Act 1972 under Schedule I, II, III, IV or V.

2. **Chart-I** : Graph of % distribution of INSECTIVOROUS BIRDS.

3. **Chart-II** : Graph of % distribution of HOLE NESTING BIRDS.

4. **Chart-III** : Graph of % distribution of BIRDS OF PREY.

### 5. List Globally Threatened Birds:

Birds under this category are those included in Threatened Birds of India – by B N H S, which need attention to position their status and survival.

### 6. Map of Bandipur National Park.

## Results and Discussion

### Distribution of Insectivorous Birds

#### Moist deciduous forest

The first phase concluded 65% of Insectivorous birds, the second phase recorded 64%, the third phase 71% and the fourth phase recorded 71% evenly.

#### Dry deciduous forest

The first phase concluded 59% of Insectivorous birds, the second phase recorded 47%, the third phase recorded 50% and the fourth phase recorded 64%.

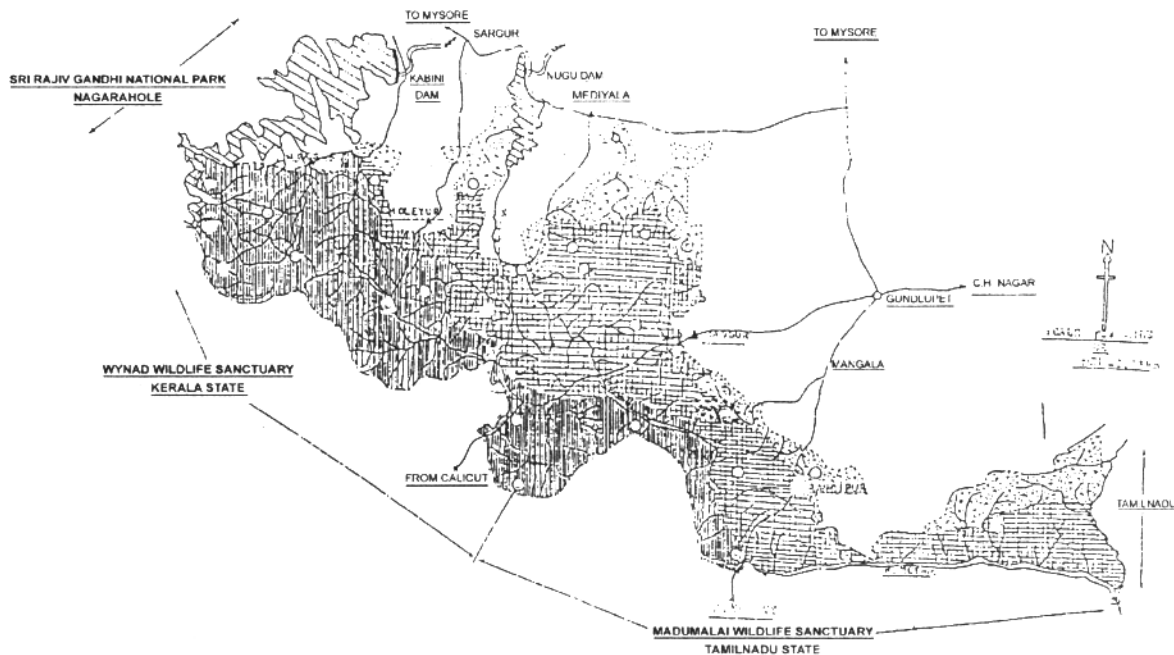
#### Riverine

The first phase concluded 64% of Insectivorous birds, the second phase recorded 65%, the third phase recorded 60% and the fourth phase recorded 59%.

#### Scrub jungle

The first phase concluded 60% of Insectivorous birds, the second phase recorded 49%, the third phase recorded 53% and the fourth phase recorded 54%.

## Map of Bandipura National Park



### **Grass hills**

The first phase concluded 45% of Insectivorous birds, the second phase recorded 84%, the third phase recorded 45% and the fourth phase recorded 67%.

### **Distribution of Hole Nesting Birds**

#### **Moist deciduous forest**

The first phase concluded 36% of Hole nesting birds, the second phase recorded 45%, the third phase 42% and the fourth phase recorded 45% respectively.

#### **Dry deciduous forest**

The first phase concluded 31% of Hole nesting birds, the second phase recorded 38%, the third phase recorded 39% and the fourth phase recorded 35%.

#### **Riverine**

The first phase concluded 30% of Hole nesting birds, the second phase recorded 29%, the third phase recorded 34% and the fourth phase recorded 37%.

#### **Scrub jungle**

The first phase concluded 14% of Hole nesting birds, the second phase recorded 20%, the third phase recorded 27% and the fourth phase recorded 17%.

### **Grass hills**

The first phase concluded 20% of Hole nesting birds, the second phase recorded 17%, the third phase recorded 10% and the fourth phase recorded 5%.

### **Distribution of Birds of Prey**

#### **Moist deciduous**

The first phase concluded 3% of Birds of Prey, the second phase recorded 3%, the third phase recorded 2% and the fourth phase recorded 2%.

#### **Dry deciduous**

The first phase concluded 2% of Birds of Prey, the second phase recorded 1%, the third phase recorded 2% and the fourth phase recorded 2%.

#### **Riverine**

The first phase concluded 6% of Birds of Prey, the second phase recorded 5%, the third phase recorded 5% and the fourth phase recorded 4%.

#### **Scrub jungle**

The first phase concluded 3% of Birds of Prey, the second phase recorded 2%, the third phase recorded 5% and the fourth phase recorded 2%.

### **Grass hills**

The first phase concluded 3% of Birds of Prey, the second phase recorded 7%, the third phase recorded 6% and the fourth phase recorded 2%.

### **Major Threats**

- \* People in India traditionally have been conserving Birds and Wildlife with religious thinking, which forbid them from killing animals, birds and destroying forest, which had socio-religious values.
- \* The development activities curbing the near need for modernity, over population, conversion of forested land to arable land and commendable change in the rural and urban life style are a few threat to bird life in India.
- \* Collection of fire wood & illegal timber gathering.
- \* Cattle grazing inside the National park pose few serious threats to bird life.
- \* Pesticides, detergent input, over fishing, and vanishing wetlands, are some threats to resident and migratory water birds.
- \* Human disturbance all along the national park border, another factor directly affecting bird life.
- \* Fast driving vehicles in highways causing road deaths of birds and animals.
- \* Poaching of birds, by nets and other means of illegal capture.

### **Conservation**

- \* A sustainable lifestyle, non-dependency on forest resources added with determined protection of their wildlife by people's participation.
- \* Stopping cattle grazing inside National park area.
- \* Highway that is cutting through the national park should be diverted.
- \* Protection of National parks as the last lung space for the in-numerable life forms.
- \* Use of alternative energy source, indirectly release pressure on forest.
- \* These are some of the acute elements, which is much talked than done, a local community headed conservation strategy should be "save our wildlife" slogan.

Total checklist of birds recorded at Bandipur National Park 2002 - 2003

| S.No | Common Name                                     | Scientific Names                   | Status Thrtnd | Wld act |
|------|-------------------------------------------------|------------------------------------|---------------|---------|
|      | <b>Grebes</b>                                   | <b>Podicipedidae</b>               |               |         |
| 1    | Little Grebe (5)                                | <i>Tachybaptus ruficollis</i>      | Br/R          | S-IV    |
|      | <b>Cormorants</b>                               | <b>Phalacrocoracidae</b>           |               |         |
| 2    | Great Cormorant (26)                            | <i>Phalacrocorax carbo</i>         | Br/R          | S-IV    |
| 3    | Indian Shag (27)                                | <i>Phalacrocorax fuscicollis</i>   | R             | S-IV    |
| 4    | Little Cormorant (28)                           | <i>Phalacrocorax niger</i>         | Br/R          | S-IV    |
|      | <b>Darters</b>                                  | <b>Anhingidae</b>                  |               |         |
| 5    | Darter (29)                                     | <i>Anhinga melanogaster</i>        | Br/R          | S-IV NT |
|      | <b>Hérons, Egrets &amp; Bitterns</b>            | <b>Ardeidae</b>                    |               |         |
| 6    | Grey Heron (35-36)                              | <i>Ardea cinerea</i>               | R             | S-IV    |
| 7    | Purple Heron (37-37a)                           | <i>Ardea purpurea</i>              | Br/R          | S-IV    |
| 8    | Indian Pond - Heron (42-42a)                    | <i>Ardeola grayii</i>              | Br/R          | S-IV    |
| 9    | Little Green Heron (38)                         | <i>Butorides striatus</i>          | R             | S-IV    |
| 10   | Cattle Egret (44)                               | <i>Bubulcus ibis</i>               | Br/R          | S-IV    |
| 11   | Large Egret (45-46)                             | <i>Casmerodius albus</i>           | Lm            | S-IV    |
| 12   | Little Egret (49)                               | <i>Egretta garzetta</i>            | Br/R          | S-IV    |
| 13   | Median Egret (47,48)                            | <i>Mesophoyx intermedia</i>        | Lm            | S-IV    |
| 14   | Black-crowned Night-Heron (52)                  | <i>Nycticorax nycticorax</i>       | Br/R          | S-IV    |
|      | <b>Storks</b>                                   | <b>Ciconiidae</b>                  |               |         |
| 15   | Painted Stork (60)                              | <i>Mycteria leucocephala</i>       | Lm            | S-IV NT |
| 16   | White-necked Stork (62)                         | <i>Ciconia episcopus</i>           | Lm            | S-IV    |
| 17   | Asian Openbill-Stork (61)                       | <i>Anastomus oscitans</i>          | Lm            | S-IV    |
| 18   | Lesser Adjutant-Stork (68)                      | <i>Leptoptilos javanicus</i>       | Rr            | S-IV VU |
|      | <b>Ibises &amp; Spoonbills</b>                  | <b>Threskiornithidae</b>           |               |         |
| 19   | Glossy Ibis (71)                                | <i>Plegadis falcinellus</i>        | Lm            | S-IV    |
| 20   | Black Ibis (70)                                 | <i>Pseudibis papillosa</i>         | Lm            | S-IV    |
| 21   | Oriental White Ibis (69)                        | <i>Threskiornis melanocephalus</i> | Lm            | S-IV NT |
| 22   | Eurasian Spoonbill (72)                         | <i>Platalea leucorodia</i>         | Lm            | S-I     |
|      | <b>Swans, Geese &amp; Ducks</b>                 | <b>Anatidae</b>                    |               |         |
| 23   | Cotton Teal (114)                               | <i>Nettapus coromandelianus</i>    | Ww            | S-IV    |
| 24   | Common Teal (94)                                | <i>Anas crecca</i>                 | Ww            | S-IV    |
| 25   | Common Pochard (108)                            | <i>Aythya ferina</i>               | Ww            | S-IV    |
| 26   | Lesser Whistling-Duck (88)                      | <i>Dendrocygna javanica</i>        | Br/R          | S-IV    |
| 27   | Spot-billed Duck (97-99)                        | <i>Anas poecilorhyncha</i>         | Br/R          | S-IV    |
| 28   | Northern Pintail (93)                           | <i>Anas acuta</i>                  | Ww            | S-IV    |
| 29   | Garganey (104)                                  | <i>Anas querquedula</i>            | Ww            | S-IV    |
|      | <b>Hawks, Eagles, Buzzards, Vultures, Kites</b> | <b>Accipitridae</b>                |               |         |
| 30   | Black-shouldred Kite (124)                      | <i>Elanus caeruleus</i>            | Br/R          | S-I     |
| 31   | Oriental Honey-Buzzard (129-130)                | <i>Pernis ptilorhynchus</i>        | Br/R          | S-I     |
| 32   | Black Kite (132-134)                            | <i>Milvus migrans</i>              | Br/R          | S-I     |
| 33   | Brahminy Kite (135)                             | <i>Haliastur indus</i>             | Br/R          | S-I     |
| 34   | Shikra (137-140)                                | <i>Accipiter badius</i>            | Br/R          | S-I     |
| 35   | Pallid Harrier (190)                            | <i>Circus macrourus</i>            | Ww            | S-I NT  |
| 36   | Pied Harrier (192)                              | <i>Circus melanoleucos</i>         | Ww            | S-I     |
| 37   | Eurasian Sparrowhawk (147-148)                  | <i>Accipiter nisus</i>             | Ww            | S-I     |
| 38   | White-eyed Buzzard (157)                        | <i>Butastur teesa</i>              | Vg            | S-I     |



| S.No | Common Name                               | Scientific Names                 | Status Thrtnd | Wld act |
|------|-------------------------------------------|----------------------------------|---------------|---------|
| 39   | Changeable Hawk-Eagle (160-162)           | <i>Spizaetus cirrhatus</i>       | Br/R          | S-I     |
| 40   | Bonelli's Eagle (163)                     | <i>Hieraaetus fasciatus</i>      | R             | S-I     |
| 41   | Black Eagle (172)                         | <i>Ictinaetus malayensis</i>     | R             | S-I     |
| 42   | Greater Grey-headed Fish-Eagle (175-176)  | <i>Ichthyophaga ichthyaetus</i>  | Br/R          | S-I NT  |
| 43   | Red-headed Vulture (178)                  | <i>Sarcogyps calvus</i>          | R             | S-IV NT |
| 44   | Long-billed Vulture (182)                 | <i>Gyps indicus</i>              | R             | S-IV CR |
| 45   | Indian White-backed Vulture (185)         | <i>Gyps bengalensis</i>          | R             | S-IV CR |
| 46   | Egyptian Vulture (186-187)                | <i>Neophron percnopterus</i>     | Vg            | S-IV    |
| 47   | Short-toed Snake-Eagle (195)              | <i>Circaetus gallicus</i>        | R             | S-I     |
| 48   | Crested Serpent-Eagle (196-200)           | <i>Spilornis cheela</i>          | Br/R          | S-I     |
| 49   | Besra Sparrowhawk (149-151)               | <i>Accipiter virgatus</i>        | R             | S-I     |
| 50   | Booted Eagle (164)                        | <i>Hieraaetus pennatus</i>       | Vg            | S-I     |
| 51   | Long-legged Buzzard (153)                 | <i>Buteo rufinus</i>             | Rr            | S-I     |
| 52   | Crested Goshawk (144-146)                 | <i>Accipiter trivirgatus</i>     | Rr            | S-I     |
|      | <b>Osprey</b>                             | <b>Pandionidae</b>               |               |         |
| 53   | Osprey (203)                              | <i>Pandion haliaetus</i>         | Ww            | S-I     |
|      | <b>Falcons</b>                            | <b>Falconidae</b>                |               |         |
| 54   | Peregrine Falcon (209-211)                | <i>Falco peregrinus</i>          | R             | S-I     |
| 55   | Common Kestrel (222-224)                  | <i>Falco tinnunculus</i>         | R             | S-IV    |
|      | <b>Pheasants, Partridges &amp; Quails</b> | <b>Phasianidae</b>               |               |         |
| 56   | Jungle Bush-Quail (255-258)               | <i>Perdica asiatica</i>          | Br/R          | S-IV    |
| 57   | Red Spurfowl (275-277)                    | <i>Gallus sonneratii</i>         | Br/R          | S-IV    |
| 58   | Grey Junglefowl (301)                     | <i>Gallus sonneratii</i>         | Br/R          | S-IV    |
| 59   | Grey Francolin (244-246)                  | <i>Francolinus pondicerianus</i> | Br/R          | S-IV    |
| 60   | Painted Bush-Quail (262-263)              | <i>Perdica erythrorhyncha</i>    | Br/R          | S-IV    |
| 61   | Indian Peafowl (311)                      | <i>Pavo cristatus</i>            | Br/R          | S-I     |
|      | <b>Buttonquails</b>                       | <b>Turnicidae</b>                |               |         |
| 62   | Yellow-legged Buttonquail (314-315)       | <i>Turnix tanki</i>              | Br/R          | S-IV    |
|      | <b>Moorhens &amp; Coots</b>               | <b>Rallidae</b>                  |               |         |
| 63   | Common Coot (350)                         | <i>Fulica atra</i>               | Br/R          | S-IV    |
| 64   | White-breasted Waterhen (343-345)         | <i>Amaurornis phoenicurus</i>    | Br/R          | S-IV    |
| 65   | Common Moorhen (347-347a)                 | <i>Gallinula chloropus</i>       | Br/R          | S-IV    |
|      | <b>Stilts</b>                             | <b>Recurvirostridae</b>          |               |         |
| 66   | Black-winged Stilt (430)                  | <i>Himantopus himantopus</i>     | R             | S-IV    |
|      | <b>Lapwings</b>                           | <b>Charadriidae</b>              |               |         |
| 67   | Red-wattled Lapwing (366-368)             | <i>Vanellus indicus</i>          | Br/R          | S-IV    |
| 68   | Yellow-wattled Lapwing (370)              | <i>Vanellus malabaricus</i>      | Br/R          | S-IV    |
|      | <b>Sandpipers</b>                         | <b>Scolopacidae</b>              |               |         |
| 69   | Green Sandpiper (397)                     | <i>Tringa ochropus</i>           | Ww            | S-IV    |
| 70   | Common Sandpiper (401)                    | <i>Actitis hypoleucos</i>        | R             | S-IV    |
| 71   | Spotted Redshank (392)                    | <i>Tringa erythropus</i>         | Ww            | S-IV    |
| 72   | Common Redshank (393)                     | <i>Tringa totanus</i>            | Ww            | S-IV    |
| 73   | Wood Sandpiper (398)                      | <i>Tringa glareola</i>           | Ww            | S-IV    |
|      | <b>Stone-Plovers</b>                      | <b>Burhinidae</b>                |               |         |
| 74   | Great Stone-Plover (437)                  | <i>Esacus recurvirostris</i>     | R             | S-IV    |
|      | <b>Gulls &amp; Terns</b>                  | <b>Laridae</b>                   |               |         |

| S.No | Common Name                            | Scientific Names                    | Status Thrtd | Wld act |
|------|----------------------------------------|-------------------------------------|--------------|---------|
| 75   | River Tern (463)                       | <i>Strena aurantia</i>              | R            | S-IV    |
|      | <b>Pigeons &amp; Doves</b>             | <b>Columbidae</b>                   |              |         |
| 76   | Yellow-legged Green-Pigeon(503-505)    | <i>Treron phoenicoptera</i>         | R            | S-IV    |
| 77   | Blue Rock Pigeon (516-517)             | <i>Columba livia</i>                | Br/R         | N.A     |
| 78   | Red Collared-Dove (535-536)            | <i>Streptopelia tranquebarica</i>   | Br/R         | S-IV    |
| 79   | Spotted Dove (537-540)                 | <i>Streptopelia chinensis</i>       | Br/R         | S-IV    |
| 80   | Little Brown Dove (541)                | <i>Streptopelia senegalensis</i>    | Br/R         | S-IV    |
| 81   | Orange-breasted Green-Pigeon (501-502) | <i>Treron bicincta</i>              | R            | S-IV    |
| 82   | Green Imperial-Pigeon (506-508a)       | <i>Ducula aenea</i>                 | R            | S-IV    |
| 83   | Pompadour Green-Pigeon (496-500)       | <i>Treron pompadora</i>             | Br/R         | S-IV    |
| 84   | Mountain Imperial-Pigeon(510-512)      | <i>Ducula badia</i>                 | R            | S-IV    |
| 85   | Emerald dove (542-544a)                | <i>Chalcophaps indica</i>           | Br/R         | S-IV    |
| 86   | Nilgiri Wood-Pigion (521)              | <i>Columba elphinstonii</i>         | Vg           | S-IV    |
| 87   | Eurasian Collered-Dove (534)           | <i>Streptopelia decaocto</i>        | Br/R         | S-IV    |
|      | <b>Sandgrouse</b>                      | <b>Pteroclididae</b>                |              |         |
| 88   | Painted Sandgrouse (492)               | <i>Pterocles indicus</i>            | Br/R         | S-IV    |
|      | <b>Parakeets &amp; Hanging-Parrots</b> | <b>Psittacidae</b>                  |              |         |
| 89   | Rose-ringed Parakeet (549-550)         | <i>Psittacula krameri</i>           | Br/R         | S-IV    |
| 90   | Plum-headed Parakeet (557-558)         | <i>Psittacula cyanocephala</i>      | Br/R         | S-IV    |
| 91   | Blue-winged Parakeet(564)              | <i>Psittacula columboides</i>       | Br/R         | S-IV    |
| 92   | Alexandrine Parakeet (545-548)         | <i>Psittacula eupatria</i>          | Vg           | S-IV    |
| 93   | Indian Hanging-Parrot (566,567)        | <i>Loriculus vernalis</i>           | Br/R         | S-IV    |
|      | <b>Cuckoos, Malkohas &amp; Coucals</b> | <b>Cuculidae</b>                    |              |         |
| 94   | Pied Crested Cuckoo (570-571)          | <i>Clamator jacobinus</i>           | Br/R         | S-IV    |
| 95   | Brainfever Bird (573-574)              | <i>Hierococyx varius</i>            | Br/R         | S-IV    |
| 96   | Indian Cuckoo (576)                    | <i>Cuculus micropterus</i>          | Br/R         | S-IV    |
| 97   | Drongo Cuckoo (588-589)                | <i>Surniculus lugubris</i>          | Br/R         | S-IV    |
| 98   | Asian Koel (590-592)                   | <i>Eudynamys scolopacea</i>         | Br/R         | S-IV    |
| 99   | Small Green-billed Malkoha (595)       | <i>Phaenicophaeus viridirostris</i> | Br/R         | S-IV    |
| 100  | Sirkeer Malkoha ( 596-598)             | <i>Phaenicophaeus leschenaultii</i> | R            | S-IV    |
| 101  | Greater Coucal (600-602)               | <i>Centropus sinensis</i>           | Br/R         | S-IV    |
| 102  | Lesser Coucal (605)                    | <i>Centropus bengalensis</i>        | R            | S-IV    |
| 103  | Indian Plaintive Cuckoo (584)          | <i>Cacomantis passerinus</i>        | Br/R         | S-IV    |
| 104  | Large Hawk-Cuckoo (572)                | <i>Hierococyx sparveriioides</i>    | Vg           | S-IV    |
| 105  | Banded Bay Cuckoo (582-583)            | <i>Cacomantis sonneratii</i>        | Br/R         | S-IV    |
|      | <b>Barn Owls</b>                       | <b>Tytonidae</b>                    |              |         |
| 106  | Barn Owl (606-607)                     | <i>Tyto alba</i>                    | Br/R         | S-IV    |
|      | <b>Owls</b>                            | <b>Strigidae</b>                    |              |         |
| 107  | Collared Scops-Owl (619-624)           | <i>Otus bakkamoena</i>              | Br/R         | S-IV    |
| 108  | Forest Eagle-Owl (628-629)             | <i>Bubo nipalensis</i>              | Br/R         | S-IV    |
| 109  | Eurasian Eagle-Owl (625-627)           | <i>Bubo bubo</i>                    | Br/R         | S-IV    |
| 110  | Brown Fish-Owl (631-632)               | <i>Ketupa zeylonensis</i>           | Br/R         | S-IV    |
| 111  | Jungle Owlet (636-637)                 | <i>Glaucidium radiatum</i>          | Br/R         | S-IV    |
| 112  | Brown Hawk-Owl (642-645)               | <i>Ninox scutulata</i>              | R            | S-IV    |
| 113  | Brown Wood-Owl (658-660)               | <i>Strix leptogrammica</i>          | R            | S-IV    |
| 114  | Oriental Scops-Owl (616-618b)          | <i>Otus sunia</i>                   | Br/R         | S-IV    |
| 115  | Eurasian Scops-Owl (615)               | <i>Otus scops</i>                   | Br/R         | S-IV    |
| 116  | Spotted Owlet (650-652)                | <i>Athene brama</i>                 | Br/R         | S-IV    |
| 117  | Mottled wood-Owl (655-657)             | <i>Strix ocellata</i>               | R            | S-IV    |
|      | <b>Nightjars</b>                       | <b>Caprimulgidae</b>                |              |         |

| S.No | Common Name                                 | Scientific Names                | Status<br>Thrtnd | Wld act |
|------|---------------------------------------------|---------------------------------|------------------|---------|
| 118  | Common Indian Nightjar (680-681)            | <i>Caprimulgus asiaticus</i>    | Br/R             | S-IV    |
| 119  | Indian Jungle Nightjar (670-672a)           | <i>Caprimulgus indicus</i>      | Br/R             | S-IV    |
| 120  | Jerdon's Nightjar (676,677)                 | <i>Caprimulgus atripennis</i>   | Br/R             | S-IV    |
| 121  | Franklin's Nightjar (682)                   | <i>Caprimulgus affinis</i>      | Br/R             | S-IV    |
|      | <b>Swifts</b>                               | <b>Apodidae</b>                 |                  |         |
| 122  | Brown-backed Needletail-Swift (691)         | <i>Hirundapus giganteus</i>     | Br/R             | N.A     |
| 123  | House Swift (702-706)                       | <i>Apus affinis</i>             | Br/R             | N.A     |
| 124  | Pacific Swift (699-700)                     | <i>Apus pacificus</i>           | Vg               | N.A     |
| 125  | Alpine Swift (693-695)                      | <i>Tachymarptis melba</i>       | Vg               | N.A     |
| 126  | White-rumped Needletail-Swift (692)         | <i>Zoonavena sylvatica</i>      | Vg               | N.A     |
| 127  | Indian Edible-nest Swiftlet (685)           | <i>Collocalia unicolor</i>      | Br/R             | N.A     |
| 128  | Asian Palm-Swift (707-708)                  | <i>Cypsiurus balasiensis</i>    | Vg               | N.A     |
|      | <b>Tree-Swifts</b>                          | <b>Hemiprocnidae</b>            |                  |         |
| 129  | Crested Tree-Swift (709)                    | <i>Hemiprocne coronata</i>      | Br/R             | N.A     |
|      | <b>Trogon</b>                               | <b>Trogonidae</b>               |                  |         |
| 130  | Malabar Trogon (710-712)                    | <i>Harpactes fasciatus</i>      | Br/R             | S-IV    |
|      | <b>Kingfishers</b>                          | <b>Alcedinidae</b>              |                  |         |
| 131  | Lesser Pied Kingfisher (719-720)            | <i>Ceryle rudis</i>             | Br/R             | S-IV    |
| 132  | Small Blue Kingfisher (722-724)             | <i>Alcedo atthis</i>            | Br/R             | S-IV    |
| 133  | Stork-billed Kingfisher (730-732)           | <i>Halcyon capensis</i>         | Br/R             | S-IV    |
| 134  | Blue-eared Kingfisher (725)                 | <i>Alcedo meninting</i>         | Vg               | S-IV    |
| 135  | White-breasted Kingfisher (735-738)         | <i>Halcyon smyrnensis</i>       | Br/R             | S-IV    |
|      | <b>Bee-eaters</b>                           | <b>Meropidae</b>                |                  |         |
| 136  | Small Bee-eater (749-752)                   | <i>Merops orientalis</i>        | Br/R             | N.A     |
| 137  | Chestnut-headed Bee-eater (744-745)         | <i>Merops leschenaulti</i>      | R                | N.A     |
| 138  | Blue-tailed Bee-eater (748)                 | <i>Merops philippinus</i>       | Vg               | N.A     |
| 139  | Blue-bearded Bee-eater (753)                | <i>Nyctornis athertoni</i>      | Br/R             | N.A     |
|      | <b>Rollers</b>                              | <b>Coraciidae</b>               |                  |         |
| 140  | Indian Roller (755-757)                     | <i>Coracias benghalensis</i>    | Br/R             | S-IV    |
| 141  | Oriental Broad-billed Roller (758-762)      | <i>Eurystomus orientalis</i>    | Vg               | S-IV    |
|      | <b>Hoopoes</b>                              | <b>Upupidae</b>                 |                  |         |
| 142  | Common Hoopoe (763-766)                     | <i>Upupa epops</i>              | Br/R             | N.A     |
|      | <b>Hornbills</b>                            | <b>Bucerotidae</b>              |                  |         |
| 143  | Indian Grey Hornbill (767)                  | <i>Ocyrceros birostris</i>      | Br/R             | S-I     |
| 144  | Malabar Grey Hornbill (768)                 | <i>Ocyrceros griseus</i>        | Br/R             | S-I     |
| 145  | Malabar Pied Hornbill (775)                 | <i>Anthraccoceros coronatus</i> | Br/R             | S-I NT  |
|      | <b>Barbets</b>                              | <b>Capitonidae</b>              |                  |         |
| 146  | Crimson-throated Barbet (790-791)           | <i>Megalaima rubricapillus</i>  | Br/R             | S-IV    |
| 147  | Brown-headed Barbet (780-782)               | <i>Megalaima zeylanica</i>      | Br/R             | S-IV    |
| 148  | White-cheeked Barbet (785)                  | <i>Megalaima viridis</i>        | Br/R             | S-IV    |
| 149  | Coppersmith Barbet (792)                    | <i>Megalaima haemacephala</i>   | Br/R             | S-IV    |
|      | <b>Woodpeckers</b>                          | <b>Picidae</b>                  |                  |         |
| 150  | Rufous Woodpecker (802-804)                 | <i>Celeus brachyurus</i>        | Br/R             | S-IV    |
| 151  | Little Scaly-bellied Green Woodpecker (808) | <i>Picus xanthopygaeus</i>      | Br/R             | S-IV    |
| 152  | Small Yellow-naped Woodpecker (814-817)     | <i>Picus chlorolophus</i>       | Br/R             | S-IV    |
| 153  | Lesser Golden-backed Woodpecker (819)       | <i>Dinopium benghalense</i>     | Br/R             | S-IV    |

| S.No | Common Name                                | Scientific Names                 | Status<br>Thrtnd | Wld act |
|------|--------------------------------------------|----------------------------------|------------------|---------|
| 154  | Common Golden-backed Woodpecker (825-826)  | <i>Dinopium javanense</i>        | Br/R             | S-IV    |
| 155  | Great Black Woodpecker (830)               | <i>Dryocopus javensis</i>        | Br/R             | S-IV    |
| 156  | Yellow-fronted Pied Woodpecker (847)       | <i>Dendrocopus mahrattensis</i>  | Br/R             | S-IV    |
| 157  | Brown-capped Pygmy Woodpecker. (851-854)   | <i>Dendrocopus nanus</i>         | Br/R             | S-IV    |
| 158  | Black-shouldred Woodpecker (858-859)       | <i>Chrysocolaptes festivus</i>   | Br/R             | S-IV    |
| 159  | Greater Golden-backed Woodpecker (860-863) | <i>Chrysocolaptes lucidus</i>    | Br/R             | S-IV    |
| 160  | Heart-spotted Woodpecker (856)             | <i>Hemicircus canente</i>        | Br/R             | S-IV    |
| 161  | Eurasian Wryneck (796)                     | <i>Jynx torquilla</i>            | Rr               | S-IV    |
| 162  | Speckled Piculet (798-799)                 | <i>Picumnus innominatus</i>      | Br/R             | S-IV    |
|      | <b>Pittas</b>                              | <b>Pittidae</b>                  |                  |         |
| 163  | Indian Pitta (867)                         | <i>Pitta brachyura</i>           | Ww               | S-IV    |
|      | <b>Larks</b>                               | <b>Alaudidae</b>                 |                  |         |
| 164  | Ashy-crowned Sparrow-Lark (878)            | <i>Eremopterix grisea</i>        | Br/R             | S-IV    |
| 165  | Red-winged Bush-Lark (875-877)             | <i>Mirafr erythroptera</i>       | Br/R             | S-IV    |
| 166  | Singing Bush-Lark (872)                    | <i>Mirafr cantillans</i>         | Br/R             | S-IV    |
| 167  | Greater Short-toed Lark (885-886)          | <i>Calandrella brachydactyla</i> | Ww               | S-IV    |
| 168  | Malabar Crested Lark (901)                 | <i>Galerida malabarica</i>       | R                | S-IV    |
| 169  | Eastern Skylark (904-909)                  | <i>Alauda gulgula</i>            | R                | S-IV    |
|      | <b>Swallows &amp; Martins</b>              | <b>Hirundinidae</b>              |                  |         |
| 170  | Wire-tailed Swallow (921)                  | <i>Hirundo smithii</i>           | R                | N.A     |
| 171  | Red-rumped Swallow ((923-928)              | <i>Hirundo daurica</i>           | Br/R             | N.A     |
| 172  | Streak-throated Swallow (922)              | <i>Hirundo fluvicola</i>         | Br/R             | N.A     |
| 173  | Dusky Crag-Martin (914)                    | <i>Hirundo concolor</i>          | R                | N.A     |
| 174  | Common Swallow (916-918)                   | <i>Hirundo rustica</i>           | R                | N.A     |
|      | <b>Shrikes</b>                             | <b>Laniidae</b>                  |                  |         |
| 175  | Bay-backed Shrike (939-940)                | <i>Lanius vittatus</i>           | Br/R             | N.A     |
| 176  | Brown Shrike (949-950a)                    | <i>Lanius cristatus</i>          | R                | N.A     |
| 177  | Southern Grey Shrike (933-935)             | <i>Lanius meridionalis</i>       | Vg               | N.A     |
| 178  | Rufous-backed Shrike (946-948)             | <i>Lanius schach</i>             | R                | N.A     |
|      | <b>Orioles</b>                             | <b>Oriolidae</b>                 |                  |         |
| 179  | Eurasian Golden Oriole (952-953)           | <i>Oriolus oriolus</i>           | R                | S-IV    |
| 180  | Black-headed Oriole (958-960a)             | <i>Oriolus xanthornus</i>        | R                | S-IV    |
| 181  | Black-naped Oriole (954,956-957)           | <i>Oriolus chinensis</i>         | Ww               | S-IV    |
|      | <b>Drongos</b>                             | <b>Dicruridae</b>                |                  |         |
| 182  | Black Drongo (962-964)                     | <i>Dicrurus macrocercus</i>      | Br/R             | S-IV    |
| 183  | White-bellied Drongo (967-969)             | <i>Dicrurus caerulescens</i>     | Br/R             | S-IV    |
| 184  | Bronzed Drongo (971)                       | <i>Dicrurus aeneus</i>           | Br/R             | S-IV    |
| 185  | Greater Racket-tailed Drongo (976-981)     | <i>Dicrurus paradiseus</i>       | Br/R             | S-IV    |
| 186  | Spangled Drongo (973)                      | <i>Dicrurus hottentottus</i>     | R                | S-IV    |
| 187  | Ashy Drongo (965-966b)                     | <i>Dicrurus leucophaeus</i>      | Vg               | S-IV    |
|      | <b>Woodswallows</b>                        | <b>Artamidae</b>                 |                  |         |
| 188  | Ashy Woodswallow (982)                     | <i>Artamus fuscus</i>            | Br/R             | N.A     |
|      | <b>Starlings &amp; Mynas</b>               | <b>Sturnidae</b>                 |                  |         |
| 189  | Grey-headed starling (987-989)             | <i>Sturnus malabaricus</i>       | Ww               | S-IV    |



| S.No | Common Name                                       | Scientific Names                       | Status Thrnd | Wld act |
|------|---------------------------------------------------|----------------------------------------|--------------|---------|
| 190  | White-headed Starling (987-989)                   | <i>Sturnus erythropygius</i>           | R            | N A     |
| 191  | Brahminy Starling (994)                           | <i>Sturnus pagodarum</i>               | Ww           | S-IV    |
| 192  | Rosy Starling (996)                               | <i>Sturnus roseus</i>                  | Ww           | S-IV    |
| 193  | Common myna (1006-1007)                           | <i>Acridotheres tristis</i>            | Br/R         | S-IV    |
| 194  | Jungle Myna (1009-1011)                           | <i>Acridotheres fuscus</i>             | Br/R         | S-IV    |
| 195  | Southern Hill-Myna (1016)                         | <i>Gracula indica</i>                  | Br/R         | S-IV    |
|      | <b>Crows, Jays, Treepies &amp; Magpies</b>        | <b>Corvidae</b>                        |              |         |
| 196  | Indian Treepie (1030a-1034)                       | <i>Dendrocitta vagabunda</i>           | Br/R         | S-IV    |
| 197  | House Crow (1048-1051)                            | <i>Corvus splendens</i>                | Br/R         | S-V     |
| 198  | Jungle Crow (1054-1057)                           | <i>Corvus macrorhynchos</i>            | Br/R         | S-IV    |
| 199  | White-bellied Treepie (1036)                      | <i>Dendrocitta leucogastra</i>         | R            | S-IV    |
|      | <b>Cuckoo-shrikes, Woodshrikes &amp; Minivets</b> | <b>Campephagidae</b>                   |              |         |
| 200  | Pied Flycatcher-Shrike (1064-1066)                | <i>Hemipus picatus</i>                 | R            | S-IV    |
| 201  | Large Woodshrike (1067-1068)                      | <i>Tephrodornis gularis</i>            | R            | S-IV    |
| 202  | Common Woodshrike (1069-1071)                     | <i>Tephrodornis pondicerianus</i>      | R            | S-IV    |
| 203  | Large Cuckoo-Shrike (1072-1075)                   | <i>Coracina macei</i>                  | R            | S-IV    |
| 204  | Black-headed Cuckoo-Shrike (1078-1079)            | <i>Coracina melanoptera</i>            | R            | S-IV    |
| 205  | Scarlet Minivet (1080-1083)                       | <i>Pericrocotus flammeus</i>           | Br/R         | S-IV    |
| 206  | Small Minivet (1090-1095)                         | <i>Pericrocotus cinnamomeus</i>        | Br/R         | S-IV    |
| 207  | Ashy Minivet (1089a)                              | <i>Pericrocotus divaricatus</i>        | Vg           | S-IV    |
|      | <b>Ioras, Chloropsis/Leafbird, Fairy-Bluebird</b> | <b>Irenidae</b>                        |              |         |
| 208  | Common Iora (1097-1101)                           | <i>Aegithina tiphia</i>                | Br/R         | S-IV    |
| 209  | Gold-fronted Chloropsis (1103-1105)               | <i>Chloropsis aurifrons</i>            | Br/R         | S-IV    |
| 210  | Jerdon's Chloropsis (1107-1108)                   | <i>Chloropsis cochinchinensis</i>      | Br/R         | S-IV    |
| 211  | Asian Fairy-Bluebird (1109,1110)                  | <i>Irena puella</i>                    | Br/R         | S-IV    |
|      | <b>Bulbuls</b>                                    | <b>Pycnonotidae</b>                    |              |         |
| 212  | Red-whiskered Bulbul (1118-1122)                  | <i>Pycnonotus jocosus</i>              | Br/R         | S-IV    |
| 213  | Red-vented Bulbul (1126-1132)                     | <i>Pycnonotus cafer</i>                | Br/R         | S-IV    |
| 214  | Yellow-browed Bulbul (1143-1145)                  | <i>Iole indica</i>                     | R            | S-IV    |
| 215  | Black Bulbul (1148-1151)                          | <i>Hypsipetes leucocephalus</i>        | R            | S-IV    |
| 216  | Grey-headed Bulbul (1114)                         | <i>Pycnonotus priocephalus</i>         | R            | S-IV    |
| 217  | Black-crested Bulbul (1115-1117)                  | <i>Pycnonotus melanicterus</i>         | Vg           | S-IV    |
| 218  | Ruby throated Bulbul                              | <i>Pycnonotus melanicterus gularis</i> | Vg           | N A     |
| 219  | Yellow-throated Bulbul (1135)                     | <i>Pycnonotus xantholaemus</i>         | Rr           | N A     |
| 220  | White-browed Bulbul (1138-1139)                   | <i>Pycnonotus luteolus</i>             | R            | S-IV    |
|      | <b>Babblers, Laughingthrushes</b>                 | <b>Timaliinae</b>                      |              |         |
| 221  | Spotted Babbler (1152-1159)                       | <i>Pellorneum ruficeps</i>             | Br/R         | S-IV    |
| 222  | Indian Scimitar-Babbler (1172-1177)               | <i>Pomatorhinus horsfieldii</i>        | Br/R         | S-IV    |
| 223  | Rufous-bellied Babbler (1219-1223)                | <i>Dumetia hypertyra</i>               | R            | S-IV    |
| 224  | Yellow-eyed Babbler (1230-1232)                   | <i>Chrysomma sinense</i>               | R            | S-IV    |
| 225  | White-headed Babbler (1267-1268)                  | <i>Turdoides affinis</i>               | R            | S-IV    |
| 226  | Quaker Tit-Babbler (1389-1391)                    | <i>Alcippe poioicephala</i>            | R            | S-IV    |
| 227  | Large Grey Babbler (1258)                         | <i>Turdoides malcolmi</i>              | R            | S-IV    |
| 228  | Jungle Babbler (1261-1265)                        | <i>Turdoides striatus</i>              | Br/R         | S-IV    |

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| S.No | Common Name                                   | Scientific Names                 | Status Thrtnd | Wld act |
|------|-----------------------------------------------|----------------------------------|---------------|---------|
| 229  | Black-headed Babbler (1224-1227)              | <i>Rhopocichla atriceps</i>      | R             | S-IV    |
| 230  | Common Babbler (1253-1254)                    | <i>Turdoides caudatus</i>        | Lm            | S-IV    |
|      | <b>Flycatchers</b>                            | <b>Muscicapinae</b>              |               |         |
| 231  | Asian Brown Flycatcher (1407)                 | <i>Muscicapa dauurica</i>        | Br/R          | S-IV    |
| 232  | Red-throated Flycatcher (1411-1412)           | <i>Ficadula parva</i>            | Vg            | S-IV    |
| 233  | Verditer Flycatcher (1445)                    | <i>Eumyias thalassina</i>        | Br/R          | S-IV    |
| 234  | Nilgiri Flycatcher (1446)                     | <i>Eumyias albicaudata</i>       | Lm            | S-IV NT |
| 235  | Rusty-tailed Flycatcher (1409)                | <i>Muscicapa ruficauda</i>       | Lm            | S-IV    |
| 236  | Grey-headed Flycatcher (1448-1449)            | <i>Culicicapa ceylonensis</i>    | R             | S-IV    |
| 237  | Tickell's Blue-Flycatcher (1442-1443)         | <i>Cyornis tickelliae</i>        | Br/R          | S-IV    |
| 238  | White-bellied Blue-Flycatcher (1435)          | <i>Cyornis pallipes</i>          | Br/R          | S-IV    |
| 239  | Brown-breasted Flycatcher (1408)              | <i>Muscicapa muttui</i>          | Vg            | S-IV    |
| 240  | Black-and-Orange Flycatcher (1427)            | <i>Ficedula nigrorufa</i>        | Vg            | S-IV NT |
|      | <b>Monarch- &amp; Paradise-Flycatchers</b>    | <b>Monarchinae</b>               |               |         |
| 241  | Asian Paradise-Flycatcher (1406-1464)         | <i>Terpsiphone paradisi</i>      | Br/R          | S-IV    |
| 242  | Black-naped Monarch-Flycatcher (1465-1469)    | <i>Hypothymis azurea</i>         | Br/R          | S-IV    |
|      | <b>Fantail-Flycatchers</b>                    | <b>Rhipidurinae</b>              |               |         |
| 243  | White-browed Fantail-Flycatcher (1451-1453)   | <i>Rhipidura aureola</i>         | Br/R          | S-IV    |
| 244  | White-throated Fantail-Flycatcher (1454-1459) | <i>Rhipidura albicollis</i>      | Br/R          | S-IV    |
|      | <b>Prinias &amp; Warblers</b>                 | <b>Sylviinae</b>                 |               |         |
| 245  | Franklin's Prinia (1502-1505)                 | <i>Prinia hodgsonii</i>          | Br/R          | S-IV    |
| 246  | Common Tailorbird (1535-1539)                 | <i>Orthotomus sutorius</i>       | Br/R          | S-IV    |
| 247  | Ashy Prinia (1515-1518)                       | <i>Prinia socialis</i>           | Br/R          | S-IV    |
| 248  | Blyth's Reed-Warbler (1556)                   | <i>Acrocephalus dumetorum</i>    | Ww            | S-IV    |
| 249  | Thick-billed Warbler (1549)                   | <i>Acrocephalus aedon</i>        | Ww            | S-IV    |
| 250  | Booted Warbler (1562-1563)                    | <i>Hippolais caligata</i>        | Ww            | S-IV    |
| 251  | Tickell's Warbler (1579)                      | <i>Phylloscopus affinis</i>      | R             | S-IV    |
| 252  | Greenish Leaf-Warbler (1602-1605)             | <i>Phylloscopus trochiloides</i> | R             | S-IV    |
| 253  | Plain Prinia (1510-1514)                      | <i>Prinia inornata</i>           | Br/R          | S-IV    |
| 254  | Large-billed Leaf-Warbler (1601)              | <i>Phylloscopus magnirostris</i> | Ww            | S-IV    |
| 255  | Blyth's Leaf-warbler (1608-1611)              | <i>Phylloscopus reguloides</i>   | Ww            | S-IV    |
| 256  | Western Crowned Warbler (1606)                | <i>Phylloscopus occipitalis</i>  | Ww            | S-IV    |
| 257  | Jungle Prinia (1519-1523)                     | <i>Prinia sylvatica</i>          | Br/R          | S-IV    |
| 258  | Streaked Fantail-Warbler (1498-1500a)         | <i>Cisticola juncidis</i>        | Br/R          | S-IV    |
| 259  | Common Lesser Whitethroat (1567-1568)         | <i>Sylvia curruca</i>            | Vg            | S-IV    |
| 260  | Orphean Warbler (1565)                        | <i>Sylvia hortensis</i>          | Vg            | S-IV    |
|      | <b>Thrushes &amp; Robins</b>                  | <b>Turdinae</b>                  |               |         |
| 261  | Oriental Magpie-Robin (1661-1664)             | <i>Copsychus saularis</i>        | Br/R          | S-IV    |
| 262  | White-rumped Shama (1665-1668)                | <i>Copsychus malabaricus</i>     | Br/R          | S-IV    |
| 263  | Pied Bushchat (1700-1703)                     | <i>Saxicola caprata</i>          | Br/R          | S-IV    |
| 264  | Indian Robin (1717-1721)                      | <i>Saxicoloides fulicata</i>     | Br/R          | S-IV    |
| 265  | Indian Blue Robin (1650-1651)                 | <i>Luscinia brunnea</i>          | Vg            | S-IV    |
| 266  | Black Redstart (1671-1672)                    | <i>Phoenicurus ochruros</i>      | Vg            | S-IV    |
| 267  | Eurasian Blackbird (1751-1757)                | <i>Turdus merula</i>             | R             | S-IV    |

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|------|---------------------------------------|----------------------------------|---------------|---------|
| 268  | Malabar Whistling-Thrush (1728)       | <i>Myiophonus horsfieldii</i>    | Br/R          | S-IV    |
| 269  | Scaly Thrush (1741-1744)              | <i>Zoothera dauma</i>            | ?             | S-IV    |
| 270  | Orange-headed Thrush (1733-1736)      | <i>Zoothera citrina</i>          | Br/R          | S-IV    |
| 271  | Blue-headed Rock-Thrush (1723)        | <i>Monticola cinclorhynchus</i>  | Vg            | S-IV    |
|      | <b>Tits</b>                           | <b>Paridae</b>                   |               |         |
| 272  | Great Tit (1790-1797)                 | <i>Parus major</i>               | Br/R          | S-IV    |
| 273  | Black-lored Yellow Tit (1809-1811)    | <i>Parus xanthogenys</i>         | Br/R          | S-IV    |
|      | <b>Nuthatches</b>                     | <b>Sittidae</b>                  |               |         |
| 274  | Chestnut-bellied Nuthatch (1827-1831) | <i>Sitta castanea</i>            | Br/R          | N.A     |
| 275  | Velvet-fronted Nuthatch (1838)        | <i>Sitta frontalis</i>           | Br/R          | N.A     |
|      | <b>Pipits &amp; Wagtails</b>          | <b>Motacillidae</b>              |               |         |
| 275  | Paddyfield Pipit (1858-1860)          | <i>Anthus rufulus</i>            | Br/R          | S-IV    |
| 276  | Richard's Pipit (1857)                | <i>Anthus richardi</i>           | Vg            | S-IV    |
| 277  | Brown Rock Pipit (1868)               | <i>Anthus similis</i>            | Vg            | S-IV    |
| 278  | Large Pied Wagtail (1891)             | <i>Motacilla maderaspatensis</i> | R             | S-IV    |
| 279  | White Wagtail (1885-1890)             | <i>Motacilla alba</i>            | Ww            | S-IV    |
| 280  | Yellow Wagtail (1875-1880)            | <i>Motacilla flava</i>           | Ww            | S-IV    |
| 281  | Forest Wagtail (1874)                 | <i>Dendronanthus indicus</i>     | R             | S-IV    |
| 282  | Grey Wagtail (1884)                   | <i>Motacilla cinerea</i>         | R             | S-IV    |
|      | <b>Flowerpeckers</b>                  | <b>Dicaeidae</b>                 |               |         |
| 283  | Thick-billed Flowerpecker (1892-1894) | <i>Dicaeum agile</i>             | Br/R          | S-IV    |
| 284  | Tickell's Flowerpecker (1899-1900)    | <i>Dicaeum erythrorhynchos</i>   | Br/R          | S-IV    |
| 285  | Plain FlowerPecker (1901-1903)        | <i>Dicaeum concolor</i>          | R             | S-IV    |
| 286  | Nilgiri flower pecker (1902)          | <i>Dicaeum concolor concolor</i> | Vg            | N.A     |
|      | <b>Sunbirds &amp; Spiderhunters</b>   | <b>Nectariniidae</b>             |               |         |
| 287  | Purple-rumped Sunbird (1907-1908)     | <i>Nectarinia zeylonica</i>      | Br/R          | S-IV    |
| 288  | Small Sunbird (1909)                  | <i>Nectarinia minima</i>         | Br/R          | S-IV    |
| 289  | Loten's Sunbird (1911-1912)           | <i>Nectarinia lotenia</i>        | Br/R          | S-IV    |
| 290  | Purple sunbird (1916-1918)            | <i>Nectarinia asiatica</i>       | Br/R          | S-IV    |
| 291  | Little Spiderhunter (1931)            | <i>Arachnothera longirostra</i>  | Br/R          | S-IV    |
|      | <b>White-eyes</b>                     | <b>Zosteropidae</b>              |               |         |
| 292  | Oriental White-eye (1933-1936)        | <i>Zosterops palpebrosus</i>     | Br/R          | S-IV    |
|      | <b>Sparrows</b>                       | <b>Passerinae</b>                |               |         |
| 293  | House Sparrow (1938-1939a)            | <i>Passer domesticus</i>         | Br/R          | S-IV    |
| 294  | Yellow-throated Sparrow (1948-1949)   | <i>Petronia xanthocollis</i>     | Vg            | S-IV    |
|      | <b>Weavers</b>                        | <b>Ploceinae</b>                 |               |         |
| 295  | Baya Weaver (1957-1959)               | <i>Ploceus philippinus</i>       | Br/R          | S-IV    |
|      | <b>Munias</b>                         | <b>Estrildidae</b>               |               |         |
| 296  | Red Munia (1964)                      | <i>Amandava amandava</i>         | Vg            | S-IV    |
| 297  | White-rumped Munia (1967-1970)        | <i>Lonchura striata</i>          | R             | S-IV    |
| 298  | Spotted munia (1974-1975)             | <i>Lonchura punctulata</i>       | Br/R          | S-IV    |
| 299  | Black-headed Munia (1976-1978)        | <i>Lonchura malacca</i>          | R             | S-IV    |

Relative Abundance of Birds

| Common Name                                 | Scientific Name                  | Nmbrs |
|---------------------------------------------|----------------------------------|-------|
| Plum-headed Parakeet (557-558)              | <i>Psittacula cyanocephala</i>   | 1539  |
| Red-vented Bulbul (1126-1132)               | <i>Pycnonotus cafer</i>          | 1539  |
| Common myna (1006-1007)                     | <i>Acridotheres tristis</i>      | 1485  |
| Jungle babbler (1261-1265)                  | <i>Turdoides striatus</i>        | 1467  |
| Spotted Dove (537-540)                      | <i>Streptopelia chinensis</i>    | 1118  |
| Red-whiskered Bulbul (1118-1122)            | <i>Pycnonotus jocosus</i>        | 902   |
| Common Hill-Myna (1015,1017,1018)           | <i>Gracula indica</i>            | 768   |
| Blue-winged Parakeet(564)                   | <i>Psittacula cyanocephala</i>   | 716   |
| Great Tit (1790-1797)                       | <i>Parus major</i>               | 602   |
| Small Minivet (1090-1095)                   | <i>Pericrocotus cinnamomeus</i>  | 584   |
| White-bellied Drongo (967-969)              | <i>Dicrurus caerulescens</i>     | 566   |
| Jungle Myna (1009-1011)                     | <i>Acridotheres fuscus</i>       | 511   |
| White-Cheeked Barbet (785)                  | <i>Megalaima viridis</i>         | 486   |
| Scarlet Minivet (1080-1083)                 | <i>Pericrocotus flammeus</i>     | 473   |
| Grey-headed Straling (987-989)              | <i>Sturnus malabaricus</i>       | 455   |
| Greater Racket-tailed Drongo (976-981)      | <i>Dicrurus paradiseus</i>       | 444   |
| Velvet-fronted Nuthatch (1838)              | <i>Sitta frontalis</i>           | 444   |
| Lesser Golden-backed Woodpecker             | <i>Dinopium benghalense</i>      | 371   |
| Black Drongo (962-964)                      | <i>Dicrurus macrocercus</i>      | 371   |
| Grey Junglefowl (301)                       | <i>Gallus sonneratii</i>         | 311   |
| Jungle Crow (1054-1057)                     | <i>Corvus macrorhynchos</i>      | 305   |
| Indian Roller (755-757)                     | <i>Coracias benghalensis</i>     | 304   |
| Brown-headed Barbet (780-782)               | <i>Megalaima zeylanica</i>       | 302   |
| Oriental Magpie-Robin (1661-1664)           | <i>Copsychus saularis</i>        | 288   |
| Indian Treepie (1030a-1034)                 | <i>Dendrocitta vagabunda</i>     | 268   |
| Common Hoopoe (763-766)                     | <i>Upupa epops</i>               | 263   |
| Purple sunbird (1916-1918)                  | <i>Nectarinia asiatica</i>       | 249   |
| Greenish Leaf-Warbler (1602-1605)           | <i>Phylloscopus trochiloides</i> | 241   |
| Brahminy Starling (994)                     | <i>Sturnus pagodarum</i>         | 234   |
| Common Iora (1097-1101)                     | <i>Aegithina tiphia</i>          | 230   |
| Oriental White-eye (1933-1936)              | <i>Zosterops palpebrosus</i>     | 228   |
| Brainfever Bird (573-574)                   | <i>Hierococcyx varius</i>        | 226   |
| Indian Hanging-Parrot (566,567)             | <i>Loriculus vernalis</i>        | 223   |
| Red-wattled Lapwing (366-368)               | <i>Vanellus indicus</i>          | 221   |
| Indian Scimitar-Babbler (1172-1177)         | <i>Pomatorhinus horsfieldii</i>  | 211   |
| Common Swallow (916-918)                    | <i>Hirundo rustica</i>           | 199   |
| Common Golden-backed Woodpecker (825-826)   | <i>Dinopium javanense</i>        | 194   |
| Chestnut-bellied Nuthatch (1827-1831)       | <i>Sitta castanea</i>            | 190   |
| Little Brown Dove (541)                     | <i>Streptopelia senegalensis</i> | 189   |
| Green Imperial Pigeon (506-508a)            | <i>Ducula aenea</i>              | 183   |
| Indian Cuckoo (576)                         | <i>Cuculus micropterus</i>       | 180   |
| Bronzed-Drongo (971)                        | <i>Dicrurus aeneus</i>           | 180   |
| Black-headed Oriole (958-960a)              | <i>Oriolus xanthornus</i>        | 172   |
| Asian Brown Flycatcher (1407)               | <i>Muscicapa dauurica</i>        | 172   |
| Indian Pond - Heron (42-42a)                | <i>Ardeola grayii</i>            | 161   |
| Indian Peafowl (311)                        | <i>Pavo cristatus</i>            | 146   |
| White-browed Fantail-Flycatcher (1451-1453) | <i>Rhipidura aureola</i>         | 146   |
| Yellow-legged Green-Pigeon(503-505)         | <i>Treron phoenicoptera</i>      | 145   |
| Rose-ringed Parakeet (549-550)              | <i>Psittacula krameri</i>        | 141   |
| Tickell's Blue-Flycatcher (1442-1443)       | <i>Cyornis tickelliae</i>        | 141   |

| Common Name                              | Scientific Name                   | Nmbrs |
|------------------------------------------|-----------------------------------|-------|
| Purple-rumped Sunbird (1907-1908)        | <i>Nectarinia zeylonica</i>       | 139   |
| Plain FlowerPecker (1901-1903)           | <i>Dicaeum concolor</i>           | 132   |
| White-breasted Kingfisher (735-738)      | <i>Halcyon smyrnensis</i>         | 130   |
| House Crow (1048-1051)                   | <i>Corvus splendens</i>           | 129   |
| Tickell's Flowerpecker (1899-1900)       | <i>Dicaeum erythrorhynchos</i>    | 126   |
| Greater Coucal (600-602)                 | <i>Centropus sinensis</i>         | 124   |
| Small Sunbird (1909)                     | <i>Nectarinia minima</i>          | 124   |
| Small Bee-eater (749-752)                | <i>Alcedo atthis</i>              | 122   |
| Blue Rock Pigeon (516-517)               | <i>Columba livia</i>              | 120   |
| Asian Paradise-Flycatcher (1406-1464)    | <i>Terpsiphone paradisi</i>       | 119   |
| Red-rumped Swallow ((923-928)            | <i>Hirundo daurica</i>            | 118   |
| White-headed Babbler (1267-1268)         | <i>Turdoides affinis</i>          | 116   |
| Coppersmith Barbet (792)                 | <i>Megalaima haemacephala</i>     | 114   |
| Large Woodshrike (1067-1068)             | <i>Tephrodoenis gularis</i>       | 113   |
| Eurasian Golden Oriole (952-953)         | <i>Oriolus oriolus</i>            | 112   |
| Crested Tree-Swift (709)                 | <i>Hemiprocne coronata</i>        | 103   |
| Baya Weaver (1957-1959)                  | <i>Ploceus philippinus</i>        | 100   |
| Pompadour Green-Pigeon (496-500)         | <i>Treron pompadora</i>           | 99    |
| Red Collared-Dove (535-536)              | <i>Streptopelia tranquebarica</i> | 98    |
| Gold-fronted Chloropsis (1103-1105)      | <i>Chloropsis aurifrons</i>       | 96    |
| Franklin's Prinia (1502-1505)            | <i>Prinia hodgsonii</i>           | 94    |
| Common Woodshrike (1069-1071)            | <i>Tephrodoenis pondicerianus</i> | 89    |
| Common Tailorbird (1535-1539)            | <i>Orthotomus sutorius</i>        | 84    |
| Brown-capped Pygmy Woodpecker. (851-854) | <i>Dendrocopus nanus</i>          | 81    |
| White-rumped Needletail-swift (692)      | <i>Zoonavena sylvatica</i>        | 79    |
| Large Cuckoo-Shrike (1072-1075)          | <i>Coracina macei</i>             | 78    |
| Pied Bushchat (1700-1703)                | <i>Saxicola caprata</i>           | 78    |
| Crested Serpent-Eagle (196-200)          | <i>Spilornis cheela</i>           | 77    |
| Indian Edible-Nest Swiftlet (685)        | <i>Zoonavena sylvatica</i>        | 77    |
| Rufous-bellied Babbler (1219-1223)       | <i>Dumetia hyperythra</i>         | 77    |
| House Swift (702-706)                    | <i>Apus affinis</i>               | 76    |
| Grey Wagtail (1884)                      | <i>Motacilla cinerea</i>          | 76    |
| Jungle Owlet (636-637)                   | <i>Glaucidium radiatum</i>        | 75    |
| Great Black Woodpecker (830)             | <i>Dryocopus javensis</i>         | 75    |
| Ashy Drongo (965-966b)                   | <i>Dicrurus leucophaeus</i>       | 75    |
| Chestnut-headed Bee-eater (744-745)      | <i>Merops leschenaulti</i>        | 72    |
| Yellow-browed Bulbul (1143-1145)         | <i>Iole indica</i>                | 72    |
| Black-crowned Night-Heron (52)           | <i>Nycticorax nycticorax</i>      | 71    |
| Black-headed Cuckoo-Shrike (1078-1079)   | <i>Coracina melanoptera</i>       | 69    |
| Indian White-backed Vulture (185)        | <i>Gypus bengalensis</i>          | 68    |
| Bay-backed Shrike (939-940)              | <i>Lanius vittatus</i>            | 68    |
| Indian Robin (1717-1721)                 | <i>Saxicoloides fulicata</i>      | 68    |
| Grey Francolin (244-246)                 | <i>Froncolinus pondicerianus</i>  | 67    |
| White-necked Stork (62)                  | <i>Ciconia episcopus</i>          | 64    |
| Spotted Babbler (1152-1159)              | <i>Pellorneum ruficeps</i>        | 63    |
| Cattle Egret (44)                        | <i>Bubulcus ibis</i>              | 58    |
| Indian Pitta (867)                       | <i>Pitta brachyura</i>            | 58    |
| Little Egret (49)                        | <i>Egretta garzetta</i>           | 57    |
| Median Egret (47,48)                     | <i>Mesophoyx intermedia</i>       | 56    |
| Paddyfield Pipit (1858-1860)             | <i>Anthus rufulus</i>             | 55    |



| Common Name                                 | Scientific Name                    | Nmbrs |
|---------------------------------------------|------------------------------------|-------|
| Little Scaly-bellied Green Woodpecker (808) | <i>Picus xanthopygaeus</i>         | 54    |
| Rosy Starling (996)                         | <i>Sturnus roseus</i>              | 54    |
| Large Pied Wagtail (1891)                   | <i>Motacilla maderaspatensis</i>   | 54    |
| Thick-billed Flowerpecker (1892-1894)       | <i>Dicaeum agile</i>               | 54    |
| Loten's Sunbird (1911-1912)                 | <i>Nectarinia lotenia</i>          | 54    |
| Green Sandpiper                             | <i>Tringa ochropus</i>             | 48    |
| Rufous Woodpecker (802-804)                 | <i>Celeus brachyurus</i>           | 48    |
| Brahminy Kite (135)                         | <i>Haliastur indus</i>             | 47    |
| Pied Flycatcher-Shrike (1064-1066)          | <i>Hemipus picatus</i>             | 47    |
| Oriental Honey-Buzzard (129-130)            | <i>Pernis ptilorhynchus</i>        | 45    |
| Yellow-throated Sparrow (1948-1949)         | <i>Petronia xanthocollis</i>       | 44    |
| spotted munia (1974-1975)                   | <i>Lonchura punctulata</i>         | 44    |
| Blyth's Reed-Warbler (1556)                 | <i>Acrocephalus dumetorum</i>      | 43    |
| Garganey (104)                              | <i>Anas querquedula</i>            | 42    |
| Indian Jungle Nightjar (670-672a)           | <i>Caprimulgus indicus</i>         | 41    |
| Streak-throated Swallow (922)               | <i>Hirundo fluvicola</i>           | 40    |
| Ashy Prinia (1515-1518)                     | <i>Prinia socialis</i>             | 40    |
| Painted Stork (60)                          | <i>Mycteria leucocephala</i>       | 37    |
| Common Teal                                 | <i>Anas crecca</i>                 | 37    |
| Yellow-fronted Pied woodpecker (847)        | <i>Dendrocopus mahrattensis</i>    | 37    |
| Jerdon's Chloropsis (1107-1108)             | <i>Chloropsis cochinchinensis</i>  | 37    |
| Black Bulbul (1148-1151)                    | <i>Hypsipetes leucocephalus</i>    | 37    |
| Southern Grey Shrike (933-935)              | <i>Lanius meridionalis</i>         | 36    |
| Ashy Woodswallow (982)                      | <i>Artamus fuscus</i>              | 36    |
| Eurasian Blackbird (1751-1757)              | <i>Turdus merula</i>               | 36    |
| Little Cormorant (28)                       | <i>Phalacrocorax niger</i>         | 35    |
| Northern Pintail (93)                       | <i>Anas acuta</i>                  | 35    |
| Black-naped Monarch-Flycatcher (1465-1469)  | <i>Hypothymis azurea</i>           | 35    |
| Oriental White Ibis (69)                    | <i>Threskiornis melanocephalus</i> | 34    |
| Crimson-throated Barbet (790-791)           | <i>Megalaima rubricapilla</i>      | 34    |
| Black-crested Bulbul (1115-1117)            | <i>Pycnonotus melanicterus</i>     | 34    |
| Small Yellow-naped Woodpecker (814-817)     | <i>Picus chlorolophus</i>          | 33    |
| Heart-spotted Woodpecker (856)              | <i>Hemicircus canente</i>          | 33    |
| Large Hawk-Cuckoo (572)                     | <i>Hierococcyx sparveroides</i>    | 32    |
| Grey Heron (35-36)                          | <i>Ardea cinerea</i>               | 31    |
| Small Blue Kingfisher (722-724)             | <i>Alcedo atthis</i>               | 31    |
| Shikra (137-140)                            | <i>Accipiter badius</i>            | 30    |
| Red-winged Bush-Lark (875-877)              | <i>Mirafr erythroptera</i>         | 30    |
| White-headed Starling (990-992)             | <i>Sturnus malabaricus blythii</i> | 29    |
| White-bellied Treepie (1036)                | <i>Dendrocitta leucogastra</i>     | 29    |
| House Sparrow (1938-1939a)                  | <i>Passer domesticus</i>           | 29    |
| Changeable Hawk-Eagle (160-162)             | <i>Spizaetus cirrhatus</i>         | 28    |
| Red Spurfowl (275-277)                      | <i>Galloperdix spadicea</i>        | 28    |
| Black Kite (132-134)                        | <i>Milvus migrans</i>              | 27    |
| Yellow-wattled Lapwing (370)                | <i>Vanellus indicus</i>            | 27    |
| Orange-breasted Green-Pigeon (501-502)      | <i>Treron bicincta</i>             | 27    |

| Common Name                                | Scientific Name                     | Nmbrs |
|--------------------------------------------|-------------------------------------|-------|
| Indian Plaintive Cuckoo (584)              | <i>Cacomantis passerinus</i>        | 27    |
| Oriental Scops-Owl (616-618b)              | <i>Otus sunia</i>                   | 27    |
| Brown Shrike (949-950a)                    | <i>Lanius cristatus</i>             | 27    |
| White-breasted Waterhen (343-345)          | <i>Amauornis phoenicurus</i>        | 26    |
| Eurasian Collared-Dove (534)               | <i>Streptopelia decaocto</i>        | 26    |
| Greater Grey-headed Fish-Eagle (175-176)   | <i>Ichthyophaga ichthyaetus</i>     | 25    |
| Lesser Pied Kingfisher (719-720)           | <i>Ceryle rudis</i>                 | 25    |
| Black-headed babbler (1224-1227)           | <i>Rhopocichla atriceps</i>         | 25    |
| Darter (29)                                | <i>Anhinga melanogaster</i>         | 23    |
| Asian Openbill-Stork                       | <i>Anastomus oscitans</i>           | 23    |
| Asian Palm-Swift (707-708)                 | <i>Cypsiurus baliensis</i>          | 23    |
| Orange-headed Thrush (1733-1736)           | <i>Zoothera citrina</i>             | 23    |
| Small Green-billed Malkoha (595)           | <i>Phaenicophaeus viridirostris</i> | 22    |
| Greater Golden-backed Woodpecker (860-863) | <i>Chrysocolaptes lucidus</i>       | 22    |
| Common Babbler (1253-1254)                 | <i>Turdoides caudatus</i>           | 22    |
| Asian Koel (590-592)                       | <i>Eudynamis scolopacea</i>         | 21    |
| Common Indian Nightjar (680-681)           | <i>Caprimulgus asiaticus</i>        | 21    |
| White-rumped Shama (1665-1668)             | <i>Copsychus malabaricus</i>        | 21    |
| Great Cormorant (26)                       | <i>Phalacrocorax carbo</i>          | 20    |
| Plain Prinia (1510-1514)                   | <i>Prinia inornata</i>              | 20    |
| Lesser whistling-Duck (88)                 | <i>Dendrocygna javanica</i>         | 19    |
| Nilgiri Wood-Pigeon (521)                  | <i>Columba elephinstonii</i>        | 19    |
| Red-throated Flycatcher (1411-1412)        | <i>Muscicapa parva</i>              | 19    |
| Forest Wagtail (1874)                      | <i>Dendronanthus indicus</i>        | 18    |
| Black Eagle (172)                          | <i>Ictinaetus malayensis</i>        | 17    |
| River Tern (463)                           | <i>Sterna aurantia</i>              | 17    |
| Mountain Imperial-Pigeon (510-512)         | <i>Ducula badia</i>                 | 17    |
| Malabar Trogon (710-712)                   | <i>Harpactes fasciatus</i>          | 17    |
| Malabar Grey Hornbill (768)                | <i>Ocyrceros griseus</i>            | 17    |
| Asian Fairy-Bluebird (1109,1110)           | <i>Irena puella</i>                 | 17    |
| Grey-headed Flycatcher (1448-1449)         | <i>Culicicapa ceylonensis</i>       | 17    |
| Common Lesser Whitethroat (1567-1568)      | <i>Sylvia curruca</i>               | 17    |
| Black-shouldered Kite (124)                | <i>Elanus caeruleus</i>             | 16    |
| Banded Bay Cuckoo (582-583)                | <i>Cacomantis sonneratii</i>        | 16    |
| Booted Warbler (1562-1563)                 | <i>Hippolais caligata</i>           | 16    |
| Nilgiri flower pecker (1902)               | <i>Dicaeum concolor concolor</i>    | 16    |
| White-rumped Munia (1967-1970)             | <i>Lonchura striata</i>             | 16    |
| Pacific Swift (699-700)                    | <i>Apus pacificus</i>               | 15    |
| Wire-tailed Swallow (921)                  | <i>Hirundo smithii</i>              | 15    |
| Black-lored yellow Tit (1809-1811)         | <i>Parus xanthogenys</i>            | 15    |
| Jungle Bush-Quail (255-258)                | <i>Perdica asiatica</i>             | 14    |
| Franklin's nightjar (682)                  | <i>Caprimulgus affinis</i>          | 14    |
| Speckled Piculet (798-799)                 | <i>Picumnus innominatus</i>         | 14    |
| Malabar Whistling-Thrush (1728)            | <i>Myiophonus horsfieldii</i>       | 14    |
| Pallid Harrier                             | <i>Circus macrourus</i>             | 13    |
| Common Kestrel (222-224)                   | <i>Falco tinnunculus</i>            | 13    |

| Common Name                                   | Scientific Name                  | Nmbrs |
|-----------------------------------------------|----------------------------------|-------|
| Common Moorhen (347-347a)                     | <i>Gallinula chloropus</i>       | 13    |
| Brown Fish-Owl (631-632)                      | <i>Ketupa zeylonensis</i>        | 13    |
| Blue-bearded Bee-eater (753)                  | <i>Nyctornis athertoni</i>       | 13    |
| Purple Heron (37-37a)                         | <i>Ardea purpurea</i>            | 12    |
| Glossy Ibis (71)                              | <i>Plegadis falcinellus</i>      | 12    |
| Emerald dove (542-544a)                       | <i>Chalcophaps indica</i>        | 12    |
| Brown-backed Needletail Swift (691)           | <i>Hirundapus giganteus</i>      | 12    |
| Rufous-backed Shrike (946-948)                | <i>Lanius schach</i>             | 12    |
| Quaker Tit-Babbler (1389-1391)                | <i>Alcippe poiocephala</i>       | 12    |
| Spot-billed Duck (97-99)                      | <i>Anas Poecilorhyncha</i>       | 11    |
| Red-headed Vulture (178)                      | <i>Sarcogypus calvus</i>         | 11    |
| Pied Crested Cuckoo (570-571)                 | <i>Clamator jacobinus</i>        | 11    |
| Stork-billed Kingfisher (730-732)             | <i>Halcyon capensis</i>          | 11    |
| Indian Grey Hornbill (767)                    | <i>Ocyrceros birostris</i>       | 11    |
| Cotton Teal (114)                             | <i>Nettapus coromandelianus</i>  | 10    |
| Common Sandpiper (401)                        | <i>Actitis hypoleucos</i>        | 10    |
| Brown Hawk-Owl (642-645)                      | <i>Ninox scutulata</i>           | 10    |
| Brown Wood Owl (658-660)                      | <i>Strix leptogrammica</i>       | 10    |
| Sprangled Drongo (973)                        | <i>Dicrurus hottentottus</i>     | 10    |
| Large-billed Leaf-Warbler (1601)              | <i>Phylloscopus magnirostris</i> | 10    |
| Yellow Wagtail (1875-1880)                    | <i>Motacilla flava</i>           | 10    |
| Little Grebe (5)                              | <i>Tachybaptus ruficollis</i>    | 9     |
| Spotted Owlet (650-652)                       | <i>Athene brama</i>              | 9     |
| Grey-headed Bulbul (1114)                     | <i>Pycnonotus priocephalus</i>   | 9     |
| Verditer Flycatcher (1445)                    | <i>Eumyias thalassina</i>        | 9     |
| Painted Bush Quail                            | <i>Perdica erythrorhyncha</i>    | 8     |
| Blue tailed Bee-eater (748)                   | <i>Merops philippinus</i>        | 8     |
| Malabar pied Hornbill (775)                   | <i>Antracoceros coronatus</i>    | 8     |
| Black-shouldred Woodpecker (858-859)          | <i>Chrysocolaptes festivus</i>   | 8     |
| Malabar Crested Lark (901)                    | <i>Galerida malabarica</i>       | 8     |
| Black-naped Oriole (954,956-957)              | <i>Oriolus chinensis</i>         | 8     |
| Ashy Minivet (1089a)                          | <i>Pericrocotus divaricatus</i>  | 8     |
| Large Grey Babbler (1258)                     | <i>Turdoides malcolmi</i>        | 8     |
| Tickell's Warbler (1579)                      | <i>Phylloscopus affinis</i>      | 8     |
| Little Spiderhunter (1931)                    | <i>Arachnothera longirostra</i>  | 8     |
| Osprey (203)                                  | <i>Pandion haliaetus</i>         | 7     |
| Alexandrine Parakeet (545-548)                | <i>Psittacula eupatria</i>       | 7     |
| Forest Eagle-Owl (628-629)                    | <i>Bubo nipalensis</i>           | 7     |
| Jerdon's Nightjar (676,677)                   | <i>Caprimulgus atripennis</i>    | 7     |
| Rusty-tailed Flycatcher (1409)                | <i>Muscicapa ruficauda</i>       | 7     |
| White-throated Fantail-Flycatcher (1454-1459) | <i>Rhipidura albicollis</i>      | 7     |
| Jungle Prinia (1519-1523)                     | <i>Prinia sylvatica</i>          | 7     |
| Indian Blue Robin (1650-1651)                 | <i>Luscinia brunnea</i>          | 7     |
| Black-headed Munia (1976-1978)                | <i>Lonchura malacca</i>          | 7     |
| Black Ibis (70)                               | <i>Pseudibis papillosa</i>       | 6     |
| Common Pochard                                | <i>Aythya ferina</i>             | 6     |

| Common Name                            | Scientific Name                        | Nmbrs |
|----------------------------------------|----------------------------------------|-------|
| Eurasian Sparrowhawk (147-148)         | <i>Accipiter nisus</i>                 | 6     |
| Peregrine Falcon (209-211)             | <i>Falco peregrinus</i>                | 6     |
| Wood Sandpiper                         | <i>Tringa glareola</i>                 | 6     |
| Drongo Cuckoo (588-589)                | <i>Surniculus lugubris</i>             | 6     |
| Alpine Swift (693-695)                 | <i>Tachymarptis melba</i>              | 6     |
| Collared Scops-Owl (619-624)           | <i>Otus bakkamoena</i>                 | 5     |
| Ashy-crowned Sparrow-lark (878)        | <i>Eremopterix grisea</i>              | 5     |
| Singing Bush-Lark (872)                | <i>Mirafra cantillans</i>              | 5     |
| Ruby throated bulbul                   | <i>Pycnonotus melanicterus gularis</i> | 5     |
| Yellow-eyed Babbler (1230-1232)        | <i>Chrysomma sinense</i>               | 5     |
| White-bellied Blue-Flycatcher (1435)   | <i>Cyornis pallipes</i>                | 5     |
| Brown-breasted Flycatcher (1408)       | <i>Muscicapa muttui</i>                | 5     |
| Streaked Fantail-Warbler (1498-1500a)  | <i>Cisticola juncidis</i>              | 5     |
| Indian Shag (27)                       | <i>Phalacrocorax fuscicollis</i>       | 4     |
| Large Egret (45-46)                    | <i>Casmerodius albus</i>               | 4     |
| Short-toed Snake-Eagle (195)           | <i>Circaetus gallicus</i>              | 4     |
| Common coot (350)                      | <i>Fulica atra</i>                     | 4     |
| Greater Short-toed Lark (886)          | <i>Calandrella brachydactyla</i>       | 4     |
| Richard's Pipit (1857)                 | <i>Anthus richardi</i>                 | 4     |
| White Wagtail (1885-1890)              | <i>Motacilla alba</i>                  | 4     |
| Little Green Heron                     | <i>Ardeola striatus</i>                | 3     |
| Eurasian Spoonbill (72)                | <i>Platalea leucorodia</i>             | 3     |
| Bonelli's Eagle (163)                  | <i>Hieraaetus fasciatus</i>            | 3     |
| Besra Sparrowhawk (149-151)            | <i>Accipiter virgatus</i>              | 3     |
| Spotted Redshank (392)                 | <i>Tringa erythropus</i>               | 3     |
| Sirkeer Malkoha ( 596-598)             | <i>Phaenicophaeus leschenaultii</i>    | 3     |
| Lesser Coucal (605)                    | <i>Centropus bengalensis</i>           | 3     |
| Oriental Broad-billed Roller (758-762) | <i>Eurystomus orientalis</i>           | 3     |
| Eurasian Wryneck (796)                 | <i>Jynx torquilla</i>                  | 3     |
| Eastern Skylark (904-909)              | <i>Alauda gulgula</i>                  | 3     |
| Dusky Craig Martin                     | <i>Hirundo concolor</i>                | 3     |
| Pied Harrier                           | <i>Circus melanoleucos</i>             | 2     |
| Long-billed Vulture (182)              | <i>Gypus indicus</i>                   | 2     |
| Booted Eagle (164)                     | <i>Hieraaetus pennatus</i>             | 2     |
| Crested Goshawk (144-146)              | <i>Accipiter trivirgatus</i>           | 2     |
| Painted Sandgrouse                     | <i>Pterocles indicus</i>               | 2     |
| Eurasian Eagle-Owl (625-627)           | <i>Bubo bubo</i>                       | 2     |
| Blue-eared Kingfisher                  | <i>Alcedo meninting</i>                | 2     |
| Yellow throated Bulbul                 | <i>Pycnonotus xantholaemus</i>         | 2     |
| Western Crowned Warbler (1606)         | <i>Phylloscopus occipitalis</i>        | 2     |
| Black Redstart (1671-1672)             | <i>Phoenicurus ochruros</i>            | 2     |
| Blue-headed Rock-Thrush (1723)         | <i>Monticola cinclorhynchus</i>        | 2     |
| Brown Rock Pipit (1866-1869)           | <i>Anthus similis</i>                  | 2     |

### Record of Single Sighting of Birds

|    | Common Name                         | Scientific Name                | Nmbrs |
|----|-------------------------------------|--------------------------------|-------|
| 1  | Lesser Adjutant-Stork (68)          | <i>Leptoptilos javanicus</i>   | 1     |
| 2  | White-eyed Buzzard (157)            | <i>Butastur teesa</i>          | 1     |
| 3  | Egyptian Vulture (186-187)          | <i>Neophron percnopterus</i>   | 1     |
| 4  | Longlegged Buzzard (153)            | <i>Buteo rufinus</i>           | 1     |
| 5  | Yellow-Legged Buttonquail (314-315) | <i>Turnix tanki</i>            | 1     |
| 6  | Black-winged Stilt (430)            | <i>Himantopus himantopus</i>   | 1     |
| 7  | Common Redshank (393)               | <i>Tringa totanus</i>          | 1     |
| 8  | Great Stone-Plover (437)            | <i>Esacus recurvirostris</i>   | 1     |
| 9  | Barn Owl (606-607)                  | <i>Tyto alba</i>               | 1     |
| 10 | Mottled wood-Owl (655-657)          | <i>Strix ocellata</i>          | 1     |
| 11 | White browed Bulbul (1138-1139)     | <i>Pycnonotus luteolus</i>     | 1     |
| 12 | Nilgiri Flycatcher (1446)           | <i>Eumyias albicaudata</i>     | 1     |
| 13 | Black-and-Orange Flycatcher (1427)  | <i>Ficedula nigrorufa</i>      | 1     |
| 14 | Thick-billed Warbler (1892-1894)    | <i>Acrocephalus aedon</i>      | 1     |
| 15 | Blyth's Leaf-warbler (1608-1611)    | <i>Phylloscopus reguloides</i> | 1     |
| 16 | Orphean Warbler (1565)              | <i>Sylvia hortensis</i>        | 1     |
| 17 | Scaly Thrush (1741-1744)            | <i>Zoothera dauma</i>          | 1     |
| 18 | Red Munia (1964)                    | <i>Amandava amandava</i>       | 1     |

### Globally Threatened Birds

#### List of Threatened birds recorded during Bird survey at Bandipur National Park

| Sl.No. | Common Name                              | Scientific Name                    | Status |
|--------|------------------------------------------|------------------------------------|--------|
| 1      | Darter (29)                              | <i>Anhinga melanogaster</i>        | NT     |
| 2      | Painted Stork (60)                       | <i>Mycteria leucocephala</i>       | NT     |
| 3      | Lesser Adjutant-Stork (68)               | <i>Leptoptilos javanicus</i>       | VU     |
| 4      | Oriental White Ibis (69)                 | <i>Threskiornis melanocephalus</i> | NT     |
| 5      | Pallid Harrier (190)                     | <i>Circus macrourus</i>            | NT     |
| 6      | Greater Grey-headed Fish-Eagle (175-176) | <i>Ichthyophaga ichthyaetus</i>    | NT     |
| 7      | Red-headed Vulture (178)                 | <i>Sarcogypus calvus</i>           | NT     |
| 8      | Long-billed Vulture (182)                | <i>Gypus indicus</i>               | CR     |
| 9      | Indian White-backed Vulture (185)        | <i>Gypus bengalensis</i>           | CR     |
| 10     | Malabar Pied hornbill (775)              | <i>Antracoceros coronatus</i>      | NT     |
| 11     | Nilgiri Flycatcher (1446)                | <i>Eumyias albicaudata</i>         | NT     |
| 12     | Black-and-Orange Flycatcher (1427)       | <i>Ficedula nigrorufa</i>          | NT     |
| 13     | White-browed Bulbul (1138-1139)          | <i>Pycnonotus luteolus</i>         | VU     |

#### Legend:

**NT** : Near threatened.

**VU** : Vulnerable.

**CR** : Critically endangered.



### List of participants who attended the Bird survey conducted during 2002 - 2003

|                    |                     |                        |
|--------------------|---------------------|------------------------|
| Abilash.A          | Manu.P.Malibhagom   | Shibu Bhaskar          |
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| Anthony P.U.       | Namperajan A.S      | Sharavathi H.V.        |
| Arun.C.G           | Prasanth Narayan.S. | Srinivas.R.            |
| Basavaraj.G.T      | Ramachandran        | Sujatha.S.             |
| Basil Fabian Benny | Rangasamy.M         | Dr. Sukumaran.A        |
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| Dr.Badri Narayan   | Dr. Raghu K.G       | Thomas Forward         |
| Chandrashekar      | Dr. Raghu K.G       | Thripathi G.Thomas     |
| Christopher .G     | Ratnakaran.J        | Uma shankar            |
| Deepesh Misra      | Rakesh.P.S          | Unnikrishnan           |
| Dr.Dilip.K.G       | Raghu.T.N           | Usha Rajkumar          |
| Gaius Wilson       | Rakesh.P.S          | Uttaman.P.K            |
| Gunashekar M.      | Raghu.T.N           | Vinod kumar.B.naik     |
| Guruprasad.P       | Sadananda K. B.     | Vinaya Kumar Thimmappa |
| Harsha.J           | Sahana              | Vinay Puthur           |
| Jay Khuva          | Sandilya.T          | Vijay sabastian        |
| Jayasooryan.K.K    | Sashi Kumar.C       | Vijay Cavale           |
| Krishna prasad K.R | Sathish.R.          | Vinay Nag.R.           |
| Krishna Narain     | Sathyan Meppayur    | Viswanath.V.N.         |
| Kumar / Mahesh     | Sethu Madhavan      | Vinod Thomas           |
| Kunhi Krishnan     | Shamanth.J.Patil,   | Vijaya Lakshmi         |
| Mamatha.S          | Sharavathi H.V.     | Vishnu Das             |
| Dr.Manohar         |                     |                        |

### **Conclusion**

Each of the vegetation has its own unique exhilaration of bird life in its clasp; supporting breeding; feeding and surviving that are important rituals for any life form. Co-relating vegetation to bird groups is very difficult since each carry a prime niche for their survival. The above exercise is just an open expression of collective information but in no way a claim to conduit legitimate information totaling bird population in Bandipur National Park, instead an evenly formatted information which can be evaluated for future, this survey is one of those formats. We wish future Birders, Naturalists, Scientists, Wildlife managers or common man who is interested in bird life will agree to upgrade the information available in this paper and commit to conserve nature and its resources.

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Mr.Pooviah. Range Forest Officer, Bandipur National Park.

Mr.Venkategowda, Range Forest Officer.Moyar range.

Mr.Purushotham. Range Forest Officer. Moolehole.

Mr.Nagaraj.I.M Range Forest Officer. Anur Marigudi.

Mr.Tangaraj. Range Forest Officer. Gundre.

Mr.Manjunath. Range Forest Officer.N.Begur.

Mr.Nagaraj.N Range Forest Officer. Hediya.

Front office assistants, Cook, Drivers.

Foresters, Guards, Watchers their watchful eyes protected the birders in the Elephant country.

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Satyan mepayoor from Kerala, helping birders to identify the bird by its call.

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# **Nest Monitoring of Indian White-backed Vultures (*Gyps Bengalensis*) in Ahmedabad, Gujarat. Status and Conservation of Vultures (Gyps) in Gujarat State.**

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The nest monitoring of Indian White-backed Vulture (*Gyps bengalensis*) is being carried out in Ahmedabad, Gujarat (23°06'N, 72°36'E) at different locations since 1999. The nest search was carried out once a fortnight and as and when a nest was located it was observed every week. In all 129 nests were observed during six nesting seasons from 1999. Neem (*Azadirachta indica*) was the most utilized tree for nesting, probably because of its abundance.

The breeding success, mortality in birds of various age classes, including the adults and observation of sick vultures are discussed, study on carcass dump-yard at Dabhala is also discussed. Infectious disease as in other parts of country, appears to be the major cause of population Indian white-backed vulture at Ahmedabad. Status and conservation of vultures (*Gyps*) in other parts of Gujarat state is also dealt with briefly.

# Jurong Birdpark Model: An excellent concept for Bird Conservation, Education and Ecotourism

Abraham Verghese

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The Jurong Birdpark [JB] of Singapore has three areas of foci. These are: 1) to breed rare birds which are dwindling in nature, 2) to educate students and lay public on birds and life sciences and 3) to promote ecotourism. This model can be used in India too to develop programmes related to conservation, education and ecotourism. The scale of implementation though can be of a lesser magnitude. This paper therefore would highlight the Jurong Birdpark as a "study model" worthy of emulation.

The author visited the JB twice. The first visit was in 1998 when Dr A K Chakravarthy also accompanied him (Verghese, 2000). He undertook the second visit during August 2005.

## **Genesis of JB**

Dr Goh Keng Swee, the then Minister for Finance, Singapore, conceived the idea of a bird park in 1968. During a World Bank Meeting in Rio de Janeiro, Dr Goh visited a zoological garden there and was impressed with its free-flight aviary. On his return to Singapore, an idea of a large aviary matured. So, Jurong town was selected to house the aviary so that Singaporeans would have a place to escape from urban life, and relax with nature. Thus, was born the JB, which would be the first of its kind in Southeast Asia.

While JB was being built, the Park's officials urged ambassadors and foreign dignitaries to contribute birds for the new park. Soon, birds from all over the world—finches, pheasants, herons, mallards, owls, cockatoos, etc., began arriving. By the opening day, 12 countries, 7 zoos and 40 private donors had contributed birds to the Park. On 3 January 1971, Jurong Birdpark was opened to the public. It was built at a cost of \$3.5 million, excluding land cost.

## **Plan and Layout of JB**

JB is a 20.2-hectare open-concept park. It is the largest in the Asia Pacific and one of the finest bird parks in the world. Its collection of more than 9,000 birds from 600 species is among the largest in the world. The Park specialises in birds from Southeast Asia and the more exotic and colourful tropical birds.

The Park has the world's largest walk-in aviary with the tallest man-made waterfall where visitors can enjoy a close-up view of free-flying birds from Africa and South America in a tropical setting. Another walk-in aviary, the Southeast Asian Birds Aviary, showcases the region's exotic and endangered species of birds. Bird shows staged at the amphitheatre and the Falconry Arena is entertaining and educative.

The hallmark of JB is that aviaries are specially designed to closely resemble the natural habitats of the feathered species. Lakes and paddocks are built for display of waterbirds and other large flightless birds such as ostriches, rheas, emus and cassowaries. Besides the bird exhibits, there are also open spaces landscaped with exotic flowering plants such as heliconias and anthuriums. JB also attracts a variety of insect and invertebrate life, which naturally co-exist among the birds and also form a part of the food web.

## **Breeding and Research**

### **Captive Breeding**

In 1988, the BirdPark launched an active breeding programme by building its Breeding and Research Centre (BRC) for endangered birds [Table 1].

### **Endangered Species Bred at JB**

|                        |                              |
|------------------------|------------------------------|
| Umbrella Cockatoo      | Scarlet Macaw                |
| Jandaya Conure         | Bali Mynah                   |
| Razor-billed Curassow  | Brown Fish Owl               |
| White-winged Wood Duck | Monk Parakeet                |
| Lesser Flamingo        | Edward's Fig Parrot          |
| Caribbean Flamingo     | Pesquet's Parrot             |
| Harris's Hawk          | Palm Cockatoo                |
| Great Indian Hornbill  | Dalmatian Pelican            |
| Southern Pied Hornbill | Humboldt Penguin             |
| Tarctic Hornbill       | Scheepmaker's Crowned Pigeon |
| Scarlet Ibis           | Nicobar Pigeon               |
| Ornate Lory            | Great Argus Pheasant         |
| Purple-napped Lory     | Palawan Peacock Pheasant     |
| Hyacinth Macaw         | White Spoonbill              |
| Military Macaw         |                              |

## **Attractions at JB**

### **Pelican Cove**

Pelican Cove, measuring 2,500 m<sup>2</sup>, houses over 40 birds and all seven species of the pelican family. It has the world's only underwater viewing of pelican feeding, allowing visitors to observe the birds' feeding behaviour underwater. Pelican Cove is designed to simulate the pelican's habitat. It features specially created islands for the birds to roost and nest, and felled tree trunks and driftwood for perching areas.

"The Panorail, the JB's air-conditioned monorail system, traverses the cove and dips to water level for a ride through the pelican colony. A boardwalk surrounding the exhibit brings visitors as near the birds as possible. The Cove is also "wheelchair and pram-friendly," said Dr Wong Hon Mun, Executive Director, Jurong BirdPark.

According to Dr Wong, "Pelican Cove's open concept is in line with Jurong BirdPark's initiative to offer fulfilling educational experiences through outdoor learning. This interactive learning mode will also enhance effectiveness when we convey interesting trivia about the birds and messages about wildlife conservation."

### **Lory Loft**

JB celebrated the silver jubilee by opening the **Lory Loft**, marking the fourth walk-in flight aviary. **Lory Loft** is also the world's largest lory flight aviary. It offers visitors a simulation of the vast Australian "outback" or rural landscape. The windmill and bushmen's hut, all familiar Australian "outback" landmarks, evoke imagery of rustic Australia. **Lory Loft** is named after its main inhabitants, the Lories, which are found in Australia, Indonesia and Papua New Guinea. It measures 3000 m<sup>2</sup>. The highlight species is the Rainbow Lory. Lory Loft is also home to nine other species of Lories like the Black-capped Lory and Dusky Lory as well as others. From beginning to end, Lory Loft provides visitors with a 360 degrees elevated view of the environs. With the elevated boardwalk and swinging suspension bridges, visitors are 'lifted' 12 meters off ground level, for a heightened experience of the tranquil ambience. At the two-tiered central feeding tower, visitors will have the opportunity to feed the birds by hand with nectar.

### **Penguin Parade**

Occupying an area of 1,630 m<sup>2</sup>, the Penguin Parade is home to 200 penguins. The five species on exhibit are the Humboldt, the Rockhopper, the Macaroni, the Fairy and the majestic King Penguin. The Penguin

Parade, with a temperature of 16 degrees Celsius, has a large pool set against a landscape of rocks, cliffs, nesting alcoves and burrows. This simulates the birds' natural habitat in the Antarctic. A special lighting system recreates the four seasons of the year effect to enable Penguins to maintain their bio-rhythm. Visitors at the exhibit will be treated to a vast panoramic view of these fascinating birds 'flying' underwater through a specially constructed viewing gallery, which has a 30-metre wide window.

### **World of Darkness**

The World of Darkness is Asia's first nocturnal bird house, opened in 1982, exhibiting nocturnal birds through a system of reversed lighting. This system enables day to be converted into night and vice-versa. There are about 60 birds representing 17 species, which includes Night Herons and Fish Owls in their mangrove swamps, Snowy Owls on ice-capped mountains, etc.

### **Southeast Asian Birds Aviary**

This aviary is home to over 1,000 species of birds from a global total of 8,500 species. It has a large walk-in aviary in the centre where birds fly freely. Visitors will be able to admire the birds rarely seen beauty, listen to their beautiful songs and watch them as they would live in the wild. Tucked away at the bottom of the A-frames by the sides of the winding walkway, are 24 individual yet spacious aviaries that house the more delicate, endangered birds. It is landscaped to provide a simulated secondary rain forest environment for the birds to live in, it still gives many vantage points from which visitors can observe the birds closely, at leisure and in relative comfort. As part of the rain forest experience, there is a tropical thunderstorm that comes on at 12-noon daily. The rain falls in the centre of the aviary away from the visitors' walkway. The exhibit is especially attractive for tourists from temperate countries to admire our Southeast Asian birds' collection.

### **Hornbills and Toucans Exhibit**

Covering an area of 2,000m<sup>2</sup>, the exhibit houses the world's largest collection of Southeast Asian hornbills and a wide variety of South American toucans. The destruction of the tropical rainforest has led to a steady decline in the hornbill population. It is one of the aims of JB to try to breed these rare and endangered birds in captivity and thereby ensure their continued survival. The BirdPark has experienced considerable success in breeding some of the species. In fact, the Park recorded the world's first successful hatching of the Black Hornbill, Southern Pied Hornbill and Great Indian Hornbill in captivity.



### ***Royal Ramble***

It is 40-metre long walkway that takes one through the enclosure of Crowned Pigeons, the largest pigeons in the world. There will be railings to lean on and benches to sit on, for a leisurely encounter with these birds that are often mistaken for miniature peafowl.

### ***Window on Paradise***

Window on Paradise, offers a lovely ringside view of the Bird of Paradise, from a 40m long tree-top level walkway which offers a completely unobtrusive view of the birds since there is no wire mesh separating the visitor from the birds especially the 12-Wired Birds of Paradise (so named due to the 12 wired projections protruding from its tail) bred for the first time in the world by the Park. To commemorate this monumental milestone, the Park was bestowed the First Breeders Award 2001 by the American Pheasant & Waterfowl Society.

### ***Waterfall Aviary***

This newly redeveloped two-hectare Waterfall Aviary remains as the world's largest walk-in aviary with the highest man-made waterfall standing at over 30 m. It is home for some 1,500 free-flying birds and it provides visitors with a unique opportunity to watch them roost, bathe, feed and even raise their young in their nests. Set in a valley, the Aviary is landscaped with indigenous exotic plants comprising of nearly 125 species of trees, bamboo, palms and ground-cover vegetation to simulate a tropical rain forest. In addition, an artificial 8m tall tree molded from an actual 100-year-old Barking Deer's Mango tree has also been planted to enhance the rainforest landscape. Visitors can stroll along shaded walkways and enjoy the rainforest experience, which comes complete with mysterious bird calls, a rambling waterfall, and mist profusion along gorges. A rustic suspension bridge offers a breath-taking view of the waterfall while two observation posts at the top offer grand views of the Aviary.

A special highlight in the Aviary is the feeding programme of the colourful flocks of Australasian parrots at the feeding platform. Another thrilling encounter is the insect-chase of the bee-eaters of Africa and starlings in all shades of blue as they hunt after their food – grasshoppers, crickets, worms and other insects – which are released during feeding times. So, an insectary, is obviously, in place.

### ***Swan Lake***

This is located next to the Pelican Cove and has a variety of swan species like the Black-necked Swan

and the Mute Swan. At the lake, these water birds can be observed roosting, fishing and bathing at close quarters.

### ***Parrot Paradise***

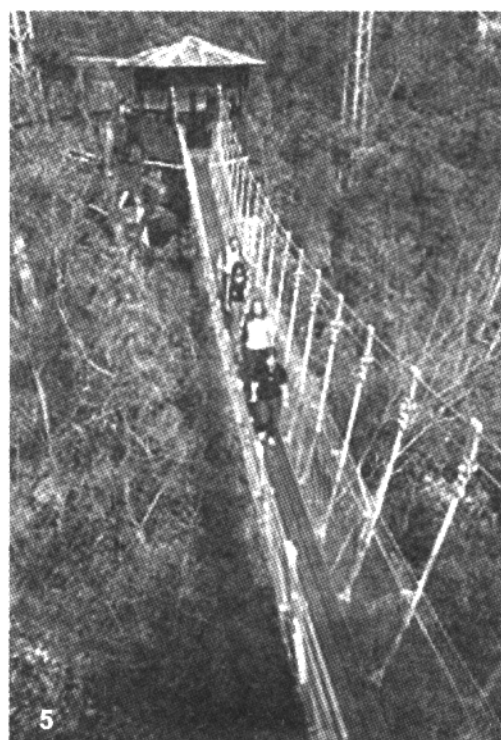
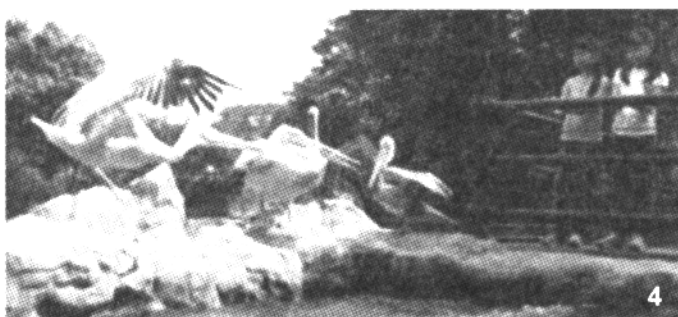
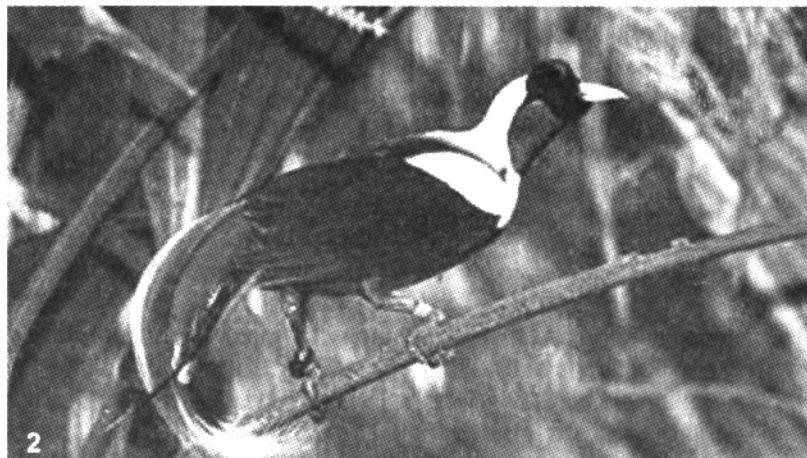
The Parrot Paradise was opened as one of the highlights of JB's 25th anniversary celebrations. A one-hectare exhibit has nearly 500 parrots from 110 species. The simulated habitats include tropical rainforest, grasslands, semi-deserts, riverbanks, and rocky cliffs. Although parrots are typically long-lived and can live up to 50 years in captivity, many species have become extinct or rare. This is the reason why special provisions have been made to encourage the breeding of parrots in captivity at the Parrot Paradise. So far, the Park has successfully bred 50 different species of the parrots in its collection. The exhibit also has an interpretative pavilion, which provides interesting information on the display panels. It houses a large, hollow, man-made tree where children can play in and learn for themselves how the parrots view the rest of the world from their nests in the hollows of tree trunks.

### ***Jungle Jewels***

Jungle Jewels is another walk-in aviary where visitors can observe at close proximity a fraction of the amazing diversity and complexity of the South American rainforest. High in the treetops live fruit-eating birds like the tanagers and cotingas. In the lower levels, honeycreepers and finches are more common. On the forest floor and streams live the waterbirds like teals and pintails. However, the hummingbirds, arguably the colourful bird in the world with their boundless energy and vibrant, iridescent plumage, are the main highlight of Jungle Jewels. Beside the walk-in aviary is an air-conditioned area, displaying hummingbirds in individual aviaries. Male and female hummingbirds are housed in specially designed breeding enclosures that allow the female access to the male while still ensuring privacy to raise her family.

### ***The Riverine***

The Riverine is a simulated natural freshwater river habitat featuring various species of waterfowl, fishes and turtles. It has been designed to give visitors an intimate underwater view of more than 20 duck species, through an 11m wide glass-viewing gallery. Filled with clear recycled water from the Park's very own industrial water treatment plant, The Riverine gives the illusion of a fast-flowing and cascading river where visitors have the unique opportunity to see these waterfowl swimming and diving.



1. Great Pied hornbill
2. Red bird of Paradise
3. Lories at feeding station
4. Pelican watch
5. 12 meters high suspension bridge (Lory loft)
6. Lories feeding from hand

*All bird pictures courtesy Jurong Birdpark*



Similar to the recently completed African Grasslands and Wetlands exhibits, which simulate natural habitats of cranes and storks, the 122 m<sup>2</sup> Riverine exhibit will also enable visitors to observe the ecological coexistence of waterfowl, plants and other animal species.

The visitor's gallery area has a seating capacity for 24 persons where they can rest and observe the diving birds in action.

The Riverine has also been equipped with special lighting and fiber optic cables for night viewing of the exhibit. Together with exhibits like the Penguin Parade and World of Darkness, these exhibits will give the BirdPark an added dimension for special night-viewing purposes.

### ***All Star Birdshow***

**Venue:** Pools Amphitheatre

**Times :** 11 am, 3 pm

Trained English-speaking staff conducts the All Star BirdShow. The highlight is an educative and lovable entertainment involving the audience totally featuring the cockatoos, macaws, flamingos, pelicans, hornbills, etc.

### ***Birds of Prey Show***

**Venue:** Fuji Hawk Walk

**Times :** 10 am, 4 pm

This is also a spectacular rewarding experience for the audience. It displays 20 different birds of prey like kites, vultures, storks, eagles, hawks all congregating to the arena obeying hunting orders from the staff, swooping on dummy animals (preys).

### ***JB Learning Centre***

The aim of this centre is to help the public by all available means to a greater understanding of birds in particular and nature in general. It is responsible for organizing various thematic exhibitions and educational programmes such as bird camps, classroom lessons, etc. The department also publishes a quarterly magazine, 'Wildlife Wonders'.

## ***Conclusions***

This paper is highlighted to stimulate educational tours to Jurong and to sensitize bird enthusiasts, NGO's, governments to start thinking of walk-in-aviaries in India. As a caution, from Indian point of view, we should not import any exotic birds, for if they escape, may become an introduced alien species of concern. Our own existing avifauna can be housed in large settings in simulated habitats to promote walk in experience to bird enthusiasts. This is truly rewarding, as opposed to watching 'imprisoned' birds in cages or grilled-huts, as in most of our zoos. Besides education, ecotourism should be the hallmark of such aviaries, to be self-sustaining. JB charges every visitor and inside the park, panorail, restaurants, souvenir shops, digital photographs with birds, picture post cards, etc., mobilize resource to run the park.

JB has a team of very dedicated staff who are highly qualified specialists. Such parks succeed only if highly linked to research. JB has won many awards for breeding rare birds. This should be our approach too. Thus an aviary, with research for breeding in captivity can attract funds from scientific agencies.

When I talk of aviaries, it should be large (a few hectares at the minimum) with simulated habitats supported by research and veterinary services, insectaries, and excellent management teams for integrating conservation, education and ecotourism. Such a model should be conceived and started. We need to take a lead from the JB model.

## ***Acknowledgements***

At the outset I thank Dr. Wong Hon Mun, the Executive Director and staff for giving me a guest privilege to have free access to the entire park, its shows and panorail facilities to make detailed studies and observations. Their website [www.birdpark.com.sg](http://www.birdpark.com.sg) and several literatures like "Feathered Facts", Map of Jurong", etc., supplied by Dr Mun helped me write this paper.

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# Bankapur Mayur Vana - an Abode of Peacocks

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A couple of years ago an article appeared in the Reader's Digest which brought out the story of a neglected ancient castle in the remote village of France which had been forgotten for centuries.

One of the local residents took a passion for it and appealed to the Government for its repair, development and upkeep. His appeal was rejected. But he did not give up. He was employed in the French Electricity Department, holding an ordinary post. His passion for restoring the old neglected monument was so much that he resigned from his post and with guts and conviction invested whatever resources he possessed and started developing the castle area. At this stage his wife also felt this was a great sacrifice for ordinary folks like them. He did not stop. An appeal was published in the French newspapers, seeking voluntary help and funds for the up-gradation of the ancient castle on the hillock, which was in ruins just outside the village. Funds started accumulating and he toiled day and night, repairing and restoring the fort and its environs.

Gradually the old castle on the hillock became a pride of the region and started attracting tourists. Soon it caught the attention of the Government and then there was no dearth of funds for restoration and maintenance.

This story of the French castle impressed Dr. Deodhar and myself as we were attracted towards a beautiful Fort in our own district, which needed attention. We started visiting the Fort at Bankapur with friends and relatives, who were particularly interested in nature and conservation. All of us were thrilled to see a large number of peacocks and other wildlife in and around the fort, which needed protection. We soon realized that the Bankapur fort area could be preserved as a haven for the peacock.

We soon called for a meeting in the Fort area. Interested citizens, leaders and various organizations of the Bankapur not only attended the meeting but also expressed their eagerness to protect the environs of the fort as a peacock sanctuary. Then we contacted Forest, Animal husbandry departments and the local Government officials. Meanwhile, Haveri got the status of a district. We invited our new Deputy Commissioner

to visit the area. We also invited district in-charge minister C.M. Udasi who was responsible to take-up the restoration of the old waterway, which was once upon a time supplying water to an ancient tank inside the fort. This was accomplished through Zillah Parishat. In the earlier days it is said that the tank could hold enough water to suffice the people inside the Fort for two consecutive years, even when the monsoon failed. The Deputy Commissioner initiated repair works and the roads inside the Fort were given a face lift. The forest Department pitched in and took up afforestation works and a watch and ward was posted by the department.

The Veterinary Department provided the needful co-operation for the peafowl protection work and poaching of peafowl eggs were contained. MP Shri M. Kunnur, the local body and M.L.A Shri Rajshekar Sindur took adequate interest in developing the Bankapur Fort area and peafowl conservation.

## ***Brief introduction of the area***

Fort area comprises of 139.10 acres, 87 acres is vested with the Veterinary Department, for the Khilari bull breeding programme. Perhaps this was one of the reasons for the protection of peafowl from poachers and most of the trees were saved from being axed by fuel wood collectors.

An impressive 66 pillar Nagareshwar temple is situated at north-west corner and at present is maintained by the Archeology Department. In addition, Yallammadevi temple is also located inside the Fort.

Fodder is grown exclusively for the Khilari bulls, all around the area, which has become an ideal peafowl habitat. Since the Fort is surrounded by a deep moat, which was once upon a time connected to the rivulet to bring water. The rivulet fed the moat during the rains, which in turn helped in increasing the water table in the neighborhood, benefiting agriculture and improving greenery in the surrounding fields.

The moat is about 36 kms long, 10 to 15 mts wide, and 7 to 8 mts deep. The banks of the moat are clothed with Accasia, Neem, and Ficus. Even the ridges are covered by trees creating a favourable habitat for the peafowl. They dwell and breed here

in relative safety. Peafowl take shelter on top of the trees during night. Eggs are laid deep inside the shrubbery on the ground during breeding season.

Agricultural crops like Maize, Jowar, and Horse gram are also grown by the Veterinary department for their cattle, which are the delicacy of the peafowl. In recent months the area is totally protected by barbed wire fence as per the directions of the new District Governor of Haveri. The Fort has five ancient battery points which give a panoramic view of the entire area.

### ***Historical background***

The History of the Fort dates back to 454 A.D. The area was ruled by the Kadambas of Banavasi. Further Gangas, Cholas, Rashtrakutas, Hoysalas, Chalukyas, Kings of Vijayanagar, Adilsha of Bijapur, Hyder Ali and Tippu Sultan had conquered and administrated the Fort from time to time. In 1888 the British regime IV of the Poona Government, declared and reserved the area exclusively for cattle breeding programmes. The efforts of Mr.Gore and Ms. Monica Gore in 1919 is noteworthy. After 1958 it came under Karnataka Government, and the area was transferred to Veterinary Department.

Bankapur Fort is in Shiggon Taluk, Haveri Dist. It is situated about 2.5 kms from the National High way No-4, and 22 kms from Haveri, the district head Quarters.

|             |                |
|-------------|----------------|
| Latitude    | 14.9 North     |
| Longitude   | 78.4 East      |
| Elevation   | 15000 M SL     |
| Rainfall    | 660 to 900 M.L |
| Temperature | 37°C to 40°C   |

The Fort is surrounded by agriculture fields. Main crops are Jowar, Cotton, Maize, Chily, Toordal, Green gram, Horse gram, and Groundnuts etc. In July 2005 a group accompanied by Mr.Harish Bhat from the Indian Institute of Science Bangalore and Prof. Madhystha from Udupi watched the peafowl in all their glory. The peacocks were seen dancing in large numbers everywhere. This Peacock Reserve or 'Mayur Vana' could be a tourist attraction and 'Birdwatchers' paradise with educational value for students. It could be a valuable asset for the State and the pride of the Nation, because our National bird can be found in its glory throughout the year. The Fort is home for not only for Peafowl, but also a number of other birds. A few are listed hereunder:-

Wood pecker, Great-horned Owl, Babbler, Magpie-Robin, Green Bee-eater, Indian Robin, Common Nightjar, Bulbuls, Spotted Dove, Spotted Munia, Parakeets, Spotted Owlet, Hoopoe, Ringed Dove, White breasted Kingfisher, Grey Hornbill, Blue-tailed Bee eater, Swallows, Brahminy Myna, Sunbird, Paradise-flycatcher, Black-winged Kite, Tailorbird, Pied Bushchat, In addition several bats and a good many varieties of butterflies have also made the Fort area as their permanent home.

### ***Current Status***

In 2002, a proposal was sent to the forest authorities for declaring this fort area as a peacock sanctuary. However this area could not be declared as a sanctuary because the area was too small. Consequent to the amendment of the Wildlife Protection Act 1972, another proposal was sent to the MoEF, New Delhi in 2005, for declaring the Bankapura Fort area as a conservation reserve for the peacocks. The issue was followed up vigorously with the assistance of ACF (WL) Ranebennur and the PCCF Wildlife. The proposal has been accepted and is currently in the process of notification as a conservation reserve.



# Monitoring of Nesting Colonies of Gyps Vultures in India

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## Abstract

Nine species of vultures are reported from Indian sub-continent, of which five belong to the genus *Gyps*. They are white-backed *Gyps bengalensis*, long-billed *Gyps indicus*, slender-billed *Gyps tenuirostris*, Himalayan griffon *Gyps himalayensis* and Eurasian griffon *Gyps fulvus*. Among the *Gyps* species, three are residents and two are largely winter visitors to the country. They are colonial or semi colonial nesting species and nests on trees, forts walls and rocky cliffs. *Gyps* vultures were once common and widely distributed across the country. The population of resident *Gyps* crashed by over 90% across the country during mid and late nineties. The present study is being carried out at various nesting locations to find out the trend in populations of these species. The present study was initiated in 2003 and is in progress.

The nesting were located in different parts of the country in the biogeographical zones of arid, semi-arid, western ghats, coastal, north-east and deccan plateau. The colonies were monitored by BNHS researchers and volunteers. The nesting sites were visited once a week during the breeding season (October to June) and information was collected on nesting population, number of nests, nest stages and mortality. The nesting colony at Bayana was intensively monitored during 2001-2005.

A total of six white-backed, four long-billed and one slender-billed nesting colonies were monitored for two

consecutive breeding seasons. A total of 386 nests of the three species were monitored between the two years. The average nesting success recorded was 66% (n=182) in white-backed vulture, 53% (n=125) in long-billed vultures and 63% (n=8) in slender-billed vulture.

The post fledgling period could be studied only in Bayana. Information on mortality could be collected at Bayana on Long-billed and at Ahmedabad on white-backed vulture. The rate of adult mortality in long-billed was 11% recorded over four years and it was 23% for white-backed vultures recorded over two years.

The *Gyps* vultures are long-living and slow breeding species. Normally they have high nesting success and low adult mortality. The breeding success recorded in the colonies was low and the adult mortality was very high. The decline in the population of the *Gyps* vultures as observed by other studies continues and it is due to high adult mortality, breeding failure and low post fledging success. The drug diclofenac which is given to the cattle has been implicated for the crash in vulture population by the earlier studies. The low nesting success and high adult mortality could be attributed to diclofenac poisoning. The ban on diclofenac for veterinary use is recommended to check the adult mortality and breeding failure.

# The Food Habits of Two species of Plovers at Nalabana Island, Chilika Lagoon, Orissa

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## Abstract

The food habit of Little Ringed Plover *Charadrius dubius* and Kentish Plover *Charadrius alexandrinus* was studied by analysing their droppings. Accidentally dead birds gut content analysed. In both the species, diet consisted of turbellarians, Polychaetes, amphipods isopods, tanaiidaceans, decapods, gastropods and bivalves. Correlation between population size and density of benthic fauna (food) revealed a negative value ( $r = -0.10$  and  $r = -0.17$  respectively) which elucidates the preference of birds towards the faunal food.

## Introduction

Majority birds migrate long distances to spend the non-breeding period in coastal wetlands ranging from north temperate to south temperate regions of the World. During this period they rely on a few key wetlands to complete their migratory cycle. These sites provide them an unique combination of food resources, safe roosting site and less disturbance which are necessary during their migration. One such potential site is Chilika lagoon in east coast of India. Few published informations are available on the diet of Plovers in the world. Skagen and Knopf (1994) studied the diet of Kentish Plover *C. alexandrinus* in relation to its habitat use at Quivira National Wildlife refuge, Kansas, North America. Inadequate studies have been made on the food habits of plovers in India. Nagarajan and Thiyagesan (1996) studied the substrate quality of Pichavaram mangrove and correlated the availability of prey groups with the habitat preferred by *C. leschenaultii*, *C. dubius* and *C. alexandrinus*. The present study was undertaken to know the food habits of two species namely *Charadrius dubius* and *Charadrius alexandrinus*.

## Study Area

Nalabana, one of the islands in Chilika lagoon is situated between latitude 19°40'N to 19°42'N and longitude 85°17'E to 85°19'E (Map). This small island covers an area of only 15.53 sq km, attracts about 94 species of birds in every migratory season for feeding and roosting. It is declared as a 'Bird Sanctuary' under Wildlife (Protection) Act, 1972. The

island remains completely submerged under water for most part of the year and is exposed gradually during winter. This feature supports wide biodiversity and lured about 75% of the total migratory bird population of the lagoon (Acharya, 2000).

## Material and Methods

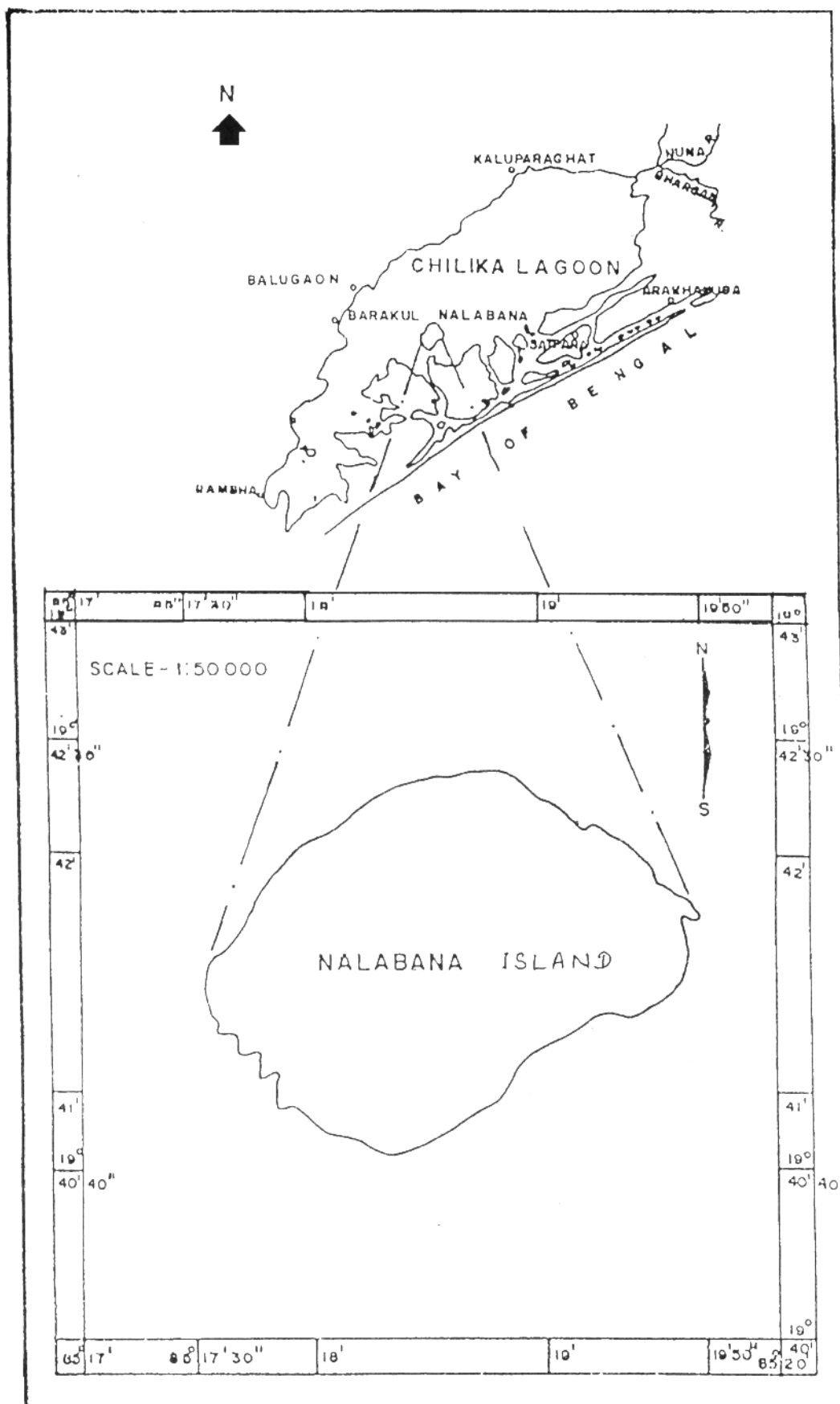
Both direct and indirect methods have been followed to study the food habits of plovers. As it is bird sanctuary and a closed area, sacrifice of live birds for study purpose is not permitted. Therefore, analysis of gut contents have been done in case of accidentally dead birds attacked by White-bellied Sea Eagle, *Haliaeetus leucogaster*. The dead birds were collected and 10% formalin was immediately injected into their stomach and oesophagi to prevent the post-mortem digestion. Later stomach and oesophagi were removed and their contents were preserved in 4% formalin. Then it was examined under a binocular microscope and prey species were identified from the fragments after Kalesta (1993).

Emphasis was given on the analysis of littoral sediments which are collected in a quadrat (10 x 10 x 8) cm<sup>3</sup> and sieved. The benthic fauna obtained were identified. The droppings of *C. dubius* and *C. alexandrinus* were collected carefully and analysed to know the dietary components which were preserved in 70% ethanol and the fragments were identified. Correlation between population size of plovers and density of benthic faunal groups was found using Pearson's correlation.

## Results

Analysis of sediments for benthic fauna brought to light 22 groups. The important groups are turbellaria, nematoda, polychaeta, amphipoda, isopoda, tanaidacea, copepoda, ostracoda, cumacea, decapoda, insecta, gastropoda and bivalvia. During the study period three accidentally dead specimens (two *C. dubius* and one *C. alexandrinus*) were collected and their gut contents were analysed.

Analysis of gut contents of *C. dubius* showed the presence of body parts of polychaetes, turbellarians, gastropods, and bivalves. Among them polychaetes



constituted 90% of total diet components whereas other three groups formed only 10%. In gut contents of *C. alexandrinus*, polychaetes, nematodes, amphipods, isopods, tanaidaceans, bivalves and gastropods were found.

Dropping samples of *C. dubius* showed head parts of amphipods and finely ground shells of bivalves and gastropods. Analysis of dropping samples of

*C. alexandrinus* revealed hard parts of chironomids, coleopterans and shells of gastropods and bivalves.

Correlation between the population size of plovers and the density of benthic fauna groups showed a negative value = ( $r = -0.10$  and  $r = -0.17$  respectively) (Table).

**Table : Correlation between population size of plovers and density of benthic faunal groups**

| Groups / plovers | <i>C. dubius</i> | <i>C. alexandrinus</i> |
|------------------|------------------|------------------------|
| Turbellaria      | -0.13            | -0.22                  |
| Polychaeta       | -0.04            | -0.13                  |
| Nematoda         | -0.21            | -0.26                  |
| Amphipoda        | -0.17            | -0.26                  |
| Isopoda          | -0.20            | -0.24                  |
| Tanaidacea       | -0.23            | -0.30                  |
| Copepoda         | -0.28            | -0.34                  |
| Ostracoda        | -0.13            | -0.21                  |
| Cumacea          | -0.37            | -0.43                  |
| Decapoda         | -0.32            | -0.38                  |
| Insecta          | 0.16             | 0.18                   |
| Gastropoda       | -0.06            | -0.13                  |
| Bivalvia         | 0.09             | 0.05                   |
| <b>Total</b>     | <b>-0.10</b>     | <b>-0.17</b>           |

'r' values at 5% = 0.304, at 1% = 0.393 (d. f. = 40)

### Discussion

Negative correlation value obtained between total plover population size and density of benthic fauna group indicates that density of benthic fauna decreases with increasing in bird population.

Negative relationship between the benthic fauna groups such as turbellaria, polychaeta, amphipoda, isopoda, tanaidacea, cumacea, decapoda, gastropoda and *C. dubius* indicates that the density of above groups decreases with increase in its population. While positive value with insecta and bivalvia reveals that high production of benthic fauna and low intake by the bird species having almost no effect on prey population. Remnants of polychaetes,

turbellarians were collected with broken shells of gastropods and bivalves from the stomach. From the droppings only fine ground shells of molluscs were obtained which indicate the birds feed on gastropods and bivalves. As the soft body of turbellarians and polychaetes were completely digested, there was no remnants of the groups in the droppings.

Negative correlation between *C. alexandrinus* with all the benthic faunal groups except insecta and bivalvia indicated that all the above groups were taken by the bird species. Analysis of gut contents of one specimen reveals the presence of polychaetes amphipods isopods, nematodes, gastropods and bivalves where as dropping analysis showed the presence of hard parts of chironomids, coleopterans ground shells of gastropods and bivalves. Nagarajan and Thiagesan (1996) worked on both the above species of plovers in Pichavaram mangrove and opined that both the species fed on polychaetes. It has been also reported that *C. dubius* fed on polychaetes supplemented by amphipods, bivalves, gastropods and crustaceans in other parts of the world which strongly supports the study (Goss - Custard, 1977; Hicklin and Smith, 1979; Pienkowski, 1982).

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# Food of the White Ibis (*Threskiornis melanocephalus* Latham) at Bhavnagar, Gujarat

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## Introduction

In spite of the wide range of distribution, surprisingly no detailed account on any aspect of the ecology and behaviour of the White Ibis (*Threskiornis melanocephalus* Latham) is available. It is widely distributed in India where it breeds throughout the subcontinent (Ali and Ripley, 1983; Hancock *et al.*, 1992).

Kushlan (1978) summarised various aspects of feeding ecology of wading birds. At present the literature on foraging ecology of wading birds is vast and long standing. However with some exceptions, the ibises are less explored. Very little is known about the White Ibis apart from general descriptions given by Dharmakumarsinhji (1955), Ali and Ripley (1983) and Hancock *et al.* (1992). A number of innovative methods have been employed by field biologists to investigate food of a bird species (Duffy and Jackson, 1986). However each method has many inherent advantages and disadvantages. Stomach content analysis is the most accurate method (Hartley, 1948), but it requires killing of birds and therefore is not justified, and even not advisable, if the species under study is rare and protected. Besides, the analysis often biased against small and soft-bodied prey that are rapidly digested in the stomach (Liffield, 1983).

Faecal pellet analysis is also one of the important methods for the study of diet composition of birds. It is a useful method to determine diet of most elusive and rare bird species when killing of birds is not desirable and direct observation is difficult to carry out. However identifying prey species from extensively fragmented hard parts in the faeces is rather difficult. Another major disadvantage of this method is incomplete quantification of food composition, compared to that of regurgitation sample and stomach content analysis (Hartley, 1948). Food items without hard parts like insect larvae could easily escape from detection due to complete digestion so that ultimately it remains underestimated. Moreover retention of certain hard parts often creates a problem in quantification of the diet (Duffy and Laurenson, 1983).

Besides all these, the wetland birds mostly defecate in water, so it is very difficult to collect the faecal pellets for analysis. Thus the degree of bias in faecal pellet analysis needs to be evaluated separately for each bird species with different prey.

The nestlings of many bird species regurgitate food when approached. Such regurgitated food material is useful for diet analysis (Kushlan and Kushlan, 1975) as there is no difference between food consumed by adults and that fed to the young.

Direct field observation on foraging individual is a better and popular method to determine food of the birds. It is ideal for birds that eat large and conspicuous food items. Further it does not require capture or killing of birds.

We present the information about the food of the White Ibis in Bhavnagar, on the basis of the study carried out during March 1993 to December 1997.

## Material and Methods

Feeding sites were located and food samples were collected every month, such collections of specimen were immediately preserved in 4% formaldehyde solution and stored in the laboratory. Size and fresh weight of each specimen were measured before the preservation. The specimens were identified up to family, genus or species level, whichever possible, using the reference collection for identification.

The qualitative analysis of food was carried out by non destructive method, as the killing of bird was not advisable. The following methods were therefore employed.

## Study Area

The present study was carried out at Bhavnagar City of Bhavnagar District in the Gujarat state of India. Bhavnagar (21°45' N, 72°08' E) is located on the south eastern side of Saurashtra region of Gujarat state. Bhavnagar City and its surrounding area falling in a radius of 20 km from the Bus Station have been



considered as the study area. The district has 120 km long sea coast with muddy coastline which provides ideal feeding ground for many wetland birds. The eastern side of the study area is surrounded by the Gulf of Khambhat. The only freshwater reservoir in the city is Bortalav (Gaurishankar lake) which gets almost dried by the end of May. Two streams namely Maleshri and Kansara flowing through the study area merge in the Gulf of Khambhat. The streams get flooded during heavy rain, but water rapidly flows down the slope and dries up within a few days.

Bhavnagar City has an underground sewer system which discharges the sewage in Motitalav and Tilaknagar areas on the outskirts of the city, they are saline wastelands at a distance of 2 km from the old port of Bhavnagar. The other important part of the study area is Ghogha port, 19km southwards from Bhavnagar, the south and north of which is muddy seashore and approximately 500 ha of the area is under mangrove plantation by the Forest Department. The mangroves and mudflats provide ideal habitats for mudskippers, prawns, shrimps and other crustaceans, which are fished out during low tides.

### **Analysis of Regurgitation samples**

Regurgitation samples were collected by climbing up the nesting tree up to the nest and forcing a nestling to disgorge recent meals since there were no differences between food consumed by adults and that fed to the young (Kushlan and Kushlan, 1975). After measuring the weight of food materials the samples were immediately preserved in 4% formaldehyde solution.

The samples were examined in the laboratory. Each identified pieces of food material was kept in a separate container. The insects and arachnids were identified from the chitinous fragments of their bodies (elytra, maxilla, legs, thorax, chelicerae, etc.) by comparing with the reference materials. Number of thorax and chelicerae were used to estimate the number of insects, prawns, shrimps, crabs etc.

### **Direct observation**

Since fishermen regularly collect mudskippers during the low tides on the muddy seashore while the White Ibis is feeding on the same site, it is not wary of human beings. Therefore, any Ibis taking food items larger than 2 cm could be easily observed with the help of 45X telescope or binoculars.

### **Indirect observation**

Several small sized and soft bodied food items (e.g. insect larvae) which get digested quickly without

leaving any indigestible remains, could escape from detection in regurgitation samples. Besides it is difficult to identify the smaller food items by direct observations in the field. As the White Ibis is a nonvisual tactile forager, it feeds on whatever is available in the substratum, so the predominant species in the foraging ground were inferred as food.

## **Results**

The White Ibis is strictly a carnivorous bird and it consumes wide variety of food (Table: 1). The diet composition was determined by following two methods.

### **Analysis of regurgitation samples**

Total 115 regurgitation samples were analysed during the study period. Table1 revealed that the major constituent of the food was mudskipper (*Boleophthalmus dussumieri*). It was found to be predominant in the diet accounting for 53.48% by weight of the total samples and occurred in 85.22% of the sample collected. The brown shrimp (*Metapenaeus dobsoni*) and white prawn (*Penaeus indicus*) also formed a major part of the diet of White ibis. Brown shrimps were accounted for 15.65% of the biomass and occurred in 52.65% of the samples, whereas white prawn was found to constitute 12.61% of the total weight of the samples and occurred in 34.78% of the samples collected. Prawns, shrimps and young ones of Bombay duck (*Harpodon nehereus*) were found to be captured by the White ibis from fishermen's nets tied on the tidal mudflats of Ghogha seashore during the low tide hours. The fingerlings of Bombay duck accounted for 2.17% of the total biomass and occurred in 2.61% of the samples. The snakehead fish (*Channa marulius*) accounted 1.74% of the biomass and, like the Bombay duck, occurred in only 2.61% of the samples. The only one molluscan prey species, freshwater mussel (*Unio* sp.) was recorded in 5.22% of the samples constituting 1.57% of the total weight. Only two annelids, earthworm (*Pheretima* sp.) and leech (*Hirudinaria granulosa*) were recorded as 1.48% and 1.57% of the biomass and occurred in 14.78% and 6.96% of the samples respectively. Ten different species of insects were identified from the diet of the ibis of which housefly larvae (*Musca domestica*) was predominated and accounted for 0.56% of the biomass and occurred in 4.35% of the samples. The rat-tailed maggots (*Tubifera* sp.) constituted 0.43% of the total biomass and occurred in 2.61% of the samples. Cockroach (*Periplaneta americana*) accounted for 0.43% of the weight and occurred in 2.61% of the samples collected. 6.96% of the biomass could not be

identified, that has found to occur in 62.61% of the samples.

A of total 20 prey species were identified by analysis of regurgitation samples (Table 1). Out of these, six belong to seashore and sewage whereas eight to freshwater bodies. The major portion of food material was marine fauna (84.17%). The prey species from sewage habitat accounted 6.18% of the total biomass, whereas minimum amount of food material (2.68%) was found from freshwater lakes.

### ***Direct observation on feeding site***

On two occasions the White Ibises were recorded capturing large sized prey, a frog of about 5 cm, and a snake of 20 cm.

In seashore habitat the White Ibises were observed feeding on mudskippers. The size of the mudskippers varied from 6 to 13 cm in length (n = 200). The ibises were also observed feeding on prawn and small sized fishes that got entangled in fishermen's net on the tidal mudflat.

### ***Indirect observation***

From sewage habitat due to availability of only small sized prey species the food items captured by the ibis could not be observed directly. However housefly larvae, chironomous larvae and rat-tailed maggots were available in large numbers in the sewage habitats.

### ***Discussion***

To summarize, fish and crustaceans are apparently the most important prey of the White Ibis at Bhavnagar, together making up 85.9 % of the diet by weight. In terms of frequency of occurrence, mudskipper, brown shrimp and white prawn were found to be most preferred food of the Ibis. The prey species belonging to fresh water habitat, like giant water bug, water scorpion, water beetle etc. were rarely eaten. Similarly, some of the food items, which belong to sewage habitat, like mayfly nymph, mosquito larvae, cockroach, etc. were also rarely eaten. A wide range of food utilized by the white ibis suggests that it consumes whatever can be captured primarily by tactile foraging methods. Some prey items are much more commonly taken than others suggests that prey species differ in availability or in the ability of the ibis to catch them. According to MacArthur (1972), a tactile foraging species that searches for its prey can be classified as a generalist, whereas species that pursue its prey can be said to be a specialist. The White Ibis is definitely a generalist based on its nonvisual tactile foraging behaviour and range of its acceptable prey.

The White Ibis is selective for certain food items. It is evident from the study that the White Ibis consumed a wide range of food in different habitat but variety of food items taken from a habitat was restricted to a few. Thus it selectively used a foraging patch where potential prey is more likely to encounter. During foraging in sewage and freshwater the White Ibis accepted less profitable items presumably because it can be consumed quickly without reducing foraging efficiency.

It was recorded that White Ibis preferred to feed on mudskipper and shrimps. Excepting these, no food item has accounted more than two percentage of biomass. This clearly suggests that predator selects a prey having greatest energy value to maximise energy gain (Emlen and Emlen, 1975). The energy value of each food item is not known. If energy content assumed to be same between prawn and mudskipper, the difference in size between them could be operative in food selection. The white ibis obviously selected large sized food items (i.e. mudskipper) to maximise feeding rate or energy gains.

The feeding ecology of the white ibis seems therefore to be characterised by opportunism in the utilization of a wide range of aquatic prey but constrained by a relatively simple repertoire of feeding behaviour. This result in many prey species being taken but in relatively few species makeup a large percentage of the biomass consumed. Based on its wide range of acceptable prey the ibis is certainly a generalist but based on the energetic contribution of various preys to the diet, it seems to be a specialist on mudskippers.

The kind of prey taken by a predator depends on the interaction between the morphology and behaviour of the predator and the size, behaviour and density of potential prey (Kushlan and Kushlan, 1975). The relatively stereotyped and primarily tactile feeding behaviour of white ibis would seemingly be selective for slow moving, sedentary, moderately sized animals and such prey do makeup most of the prey types taken in the study area. Although generalised in its use of habitat the white ibis relies heavily on only a few of the many types it consumes.

### ***Acknowledgement***

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**Table: 1 Analysis of regurgitation samples ( n= 115)**

| Food items |                       |                                  |                              |            |               |
|------------|-----------------------|----------------------------------|------------------------------|------------|---------------|
| Sr. No.    | Common name           | Scientific name                  | Order/Family                 | Weight (%) | Frequency (%) |
|            | <b>Crustacea</b>      |                                  |                              |            |               |
| 1          | Sea crab              | <i>Protunus sanguinolentus</i>   | Decapoda                     | 0.17       | 1.73          |
| 2          | White prawn           | <i>Penaeus indicus</i>           | Decapoda                     | 12.61      | 34.78         |
| 3          | Brown shrimp          | <i>Metapenaeus dobsoni</i>       | Decapoda                     | 15.65      | 52.17         |
| 4          | Crustacean larvae     | Unidentified                     |                              | 0.09       | 2.61          |
|            | <b>Insecta</b>        |                                  |                              |            |               |
| 5          | Rat tail maggot       | <i>Tubifera sp.</i>              | Diptera                      | 0.43       | 2.61          |
| 6          | Housefly larvae       | <i>Musca domestica</i>           | Diptera/Muscidae             | 0.56       | 4.35          |
| 7          | Mosquito larvae       | Unidentified                     | Diptera                      | 0.17       | 3.48          |
| 8          | Chironomous larvae    | <i>Chironomous sp.</i>           | Diptera/<br>Chironomidae     | 0.26       | 5.22          |
| 9          | Mayfly nymph          | <i>Ephemera sp.</i>              | Ephemeroptera                | 0.09       | 1.74          |
| 10         | Dung beetle           | Unidentified                     | Coleoptera/<br>Scarabaeidae  | 0.22       | 5.22          |
| 11         | Giant waterbug        | <i>Belostoma sp.</i>             | Hemiptera                    | 0.35       | 2.61          |
| 12         | Water scorpion        | <i>Nepa sp.</i>                  | Hemiptera                    | 0.3        | 3.48          |
| 13         | Water beetle          | Unidentified                     | Coleoptera/<br>Hydrophilidae | 0.39       | 4.35          |
| 14         | Cockroach             | <i>Periplaneta americana</i>     | Orthoptera                   | 0.43       | 2.61          |
|            | <b>Annelida</b>       |                                  |                              |            |               |
| 15         | Earth worm            | <i>Pheretima sp.</i>             | Oligochaeta                  | 0.87       | 14.78         |
| 16         | Leech                 | <i>Hirudinaria granulose</i>     | Archynchobdella              | 1.48       | 6.96          |
|            | <b>Mollusca</b>       |                                  |                              |            |               |
| 17         | Freshwater mussel     | <i>Unio sp</i>                   | Lamellibranchiata            | 1.57       | 5.22          |
|            | <b>Fish</b>           |                                  |                              |            |               |
| 18         | Snake head fish       | <i>Channa marulius</i>           | Ophiocephaliformes           | 1.74       | 2.61          |
| 19         | Mudskipper            | <i>Boleophthalmus dussumieri</i> | Gobiidae                     | 53.47      | 85.22         |
| 20         | Bombayduck            | <i>Harpodon nehereus</i>         | Scopeliformes                | 2.17       | 2.61          |
|            | <b>Amphibia</b>       |                                  |                              |            |               |
| 21         | Frog                  | *                                | <i>Rana sp.</i>              | -          | -             |
|            | <b>Reptiles</b>       |                                  |                              |            |               |
| 22         | Freshwater snake      | *                                | -                            | -          | -             |
| 23         | Unidentified material | -                                | -                            | 6.96       | 62.61         |

\* = Directly observed food items.

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# Roost Habitat use of Harriers Wintering in Western and Southern India

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## Introduction

Harriers are long distance migrants to India. Arriving in India by as early as late July they spread widely across the country inhabiting various geographical landscapes like open undulating plains, semi-desert areas, lowlands and cultivated country in plains and foothills up to 3000 m (Ripley 1982). Though most of the wintering harriers start leaving India for the breeding grounds by early March, a few remain till April and especially juveniles could be sighted till June. Six species of harriers winter in India. They are Pallid *Circus macrourus*, Hen *C. cyaneus*, Montagu's *C. pygargus*, Pied *C. melanoleucos*, Eurasian Marsh *C. aeruginosus* and Eastern Marsh Harriers *C. spilonotus*. Of these, Montagu's, Marsh and Pallid Harriers are widely distributed in India while Pied and Eastern Marsh Harriers are confined to the eastern parts of India whereas Hen Harriers are commonly seen in Northern India east to Upper Assam (Ali and Ripley 1983). Except Pied Harrier there is no confirmed record for any of harriers breeding in India (Narayan and Rosalind 1991). Not much is known about the origin of harriers wintering in India. However, a harrier ringed at Bharatpur, India (27° N and 77° E, Ali and Ripley 1983) on March 25, 1962 was recovered c 4000 km far away in Kazakhstan (53° N and 66° E) after three years on May 7, 1965 (Igor Fefelov; pers. commu.) which suggests that part of harrier population wintering in India come from Asian breeding grounds. According to Ali and Ripley (1983), Montagu's are slightly less common than Pallid harriers. However, once widespread in Indian subcontinent, Pallid Harriers are currently a rare sighting (Grimmett *et al.* 1998), and are now listed as a globally threatened species (BirdLife International 2000).

Harriers roost communally in their wintering grounds where they assemble every day in the evening after travelling long distances from feeding sites, if undisturbed. Roosts can be an important source of collecting information on population status of Pallid Harriers (International Action Plan for the Pallid Harrier 2003), because consistent and repeatable roost counts may allow monitoring population trends. Also these sites can be the

important source of collecting large data on diet from pellets (Errington, 1930).

Other harrier roosts occurring in India include Velavadar National Park, Gujarat (Clarke *et al.* 1998) – the world's largest roosting ground, Alwal grasslands in Secunderabad, Andhra Pradesh (Ganesh and Kanniah, 2000) and Banni grassland, Kutch, Gujarat (Samant *et al.* 1995).

## Study area and methodology

The study was conducted during 1996-2005 in arid and semi arid tracts of India in the states of Rajasthan, Maharashtra (Western India), Andhra Pradesh and Karnataka (Southern India). The various sites studied included Tal Chhaper Wildlife Sanctuary in Churu district, North Eastern Rajasthan (About 100 km from Churu district), Keoladeo National Park in Bharatpur district, Eastern Rajasthan (About 180 km South of Delhi), Akola grasslands in Akola district, North Central Maharashtra (About 14 km from City Railway Station), Mumbai aquatic grassland in Mumbai, Western Maharashtra (About 15 km from Chatrapati Shivaji Railway, Mumbai), Rollapadu Wildlife Sanctuary in Kurnool district, South Western Andhra Pradesh (About 60 km from Kurnool near Nandikotkur), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) grassland at Patancheru in Medak district, North Western Andhra Pradesh ( About 60 km from Hyderabad), Hesaraghata grassland in northern Bangalore in Southern Karnataka (About 40 Km from Bangalore), and Madiwala Lake in South Bangalore in Southern Karnataka (About 30 km from City Majestic Bus Stand). Refer Table 1 for more details about the study sites.

Informations on the occurrence of grasslands and reed beds, the preferred roosting habitat of harriers, were collected through literatures like journals and gazetteers and also by consulting local birdwatchers, villagers and authorities in the University on the related subjects. The sites were then surveyed for identifying roosts. Based on previous experience (Verma 2002) observations at each potential site were made for about three hours; two hour before one hour after



sunset, when maximum number of harriers are expected to congregate for roosting. If harriers were found heading far off in different directions they were kept following continuously till their roosts were located. This sometimes took days ranging between 2 to 30.

On confirmation of harrier-roost, observations were made on their number and habitat from vantage points using 8x50 binoculars for three hours; two hours before and an hour after sunset in fine weathers. Roosting population was estimated by counting harriers in flight arriving to roost by two persons. The observers kept scanning all around the roost at every 2 minutes interval for harriers. Information on roost habitat use was also collected during the following day after harriers had left the roost for hunting grounds. The actual roost sites of harriers were identified by the presence of excreta, downy feathers and pellets. Information on vegetation types, height, phenology, approximate roost size, distance from road and water body and human habitation were recorded.

## Results

The harriers were found using large open tracts of grasslands tall enough to conceal them completely. They arrived about 1 to 2 hours prior to roosting congregating close to roosting site in open grounds. Few also perched on trees bordering the roost. Here, they spent considerable time resting, preening and vocalizing at arrival of conspecifics. Males were mostly silent. Just after sunset they would leave their pre roosting perches moving one after another towards the roost. After an intensive low soaring over the roost all would drop down into the vegetation for roosting within half an hour of sunset. (Table 1)

## Roost habitat and roosting harriers

It was observed that harriers mostly used tall grasslands for roosting. Occasionally they roosted in wetlands and bare grounds. See table 2 for various features of roost sites studied both in western and southern India.

### Western India

At Tal Chhapar, the harrier roost habitat comprised of various grass species (*Lasiurus indicus*), sedges (*Cyperus rotundus*) and herbs (*Heliozylane cellicornicum*). Harriers used the sanctuary as a staging ground for a month of September especially and by early October almost all had left the area. The two roost counts made on 27<sup>th</sup> and 28<sup>th</sup> of September 2005 showed the number of roosting harriers to be

43 and 3 respectively. Potential predators for harriers could be Jungle Cat *Felis chaus*, Jackal *Canis aureus* and Indian Fox *Vulpes bengalensis* which inhabit the sanctuary. One Female Montagu's harrier was found predated with its wings and claws uneaten.

At Keoladeo, a tall grassland comprising of *Vetiveria zizanioides* (coarse and c1.9 m tall) and *Desmostachya bipinnata* (soft and c1.1 m tall) located in the southeast of the Park formed the roost habitat for harriers. The long term study conducted at Keoladeo on harriers found it to be a major and regular roost of Eurasian Marsh harriers where up to 132 individuals roosted in November (Verma 2002). Roost counts made during 2<sup>nd</sup> January and 10<sup>th</sup> February 2005 recorded 19 and 11 harriers respectively. During 1996-97 and 1997-98 they were recorded using grasslands, wetlands with floating Water-hyacinth (*Eichornia crassipes*) and on bare ground in ploughed fields. The maximum roosting individuals recorded at wetland and bare ground was about 50 and 30 respectively. In the grasslands, the harriers created individual roost sites by trampling the grass, however also used natural depressions and the resting sites of ungulates mostly Spotted Deer *Axis axis* and Nilgai *Boselaphus tragocamelus* while in wetlands they used taller Water-hyacinth with brown dry leaves at the top. The potential predators sighted at grassland roosts included Jungle Cat, Jackal and Striped Hyena *Hyaena hyaena*.

At Akola, the roost habitat was a grass dominated area interspersed with herbs (*Ischaemum rugosum*, *Themeda quadrivalvis*, *Sehima notatum*, *Aristida funiculata*, *Heteropogon contortus*, *Lophopogon tridentatus*, *Chrysopogon fulvus*, *Dichanthium annulatum*, *Panicum deccanense*) (*Brachiaria deflexa*, *Tragus roxburghii*, *Oplismenus burmanii*, *Cenchrus setigerus*, *paludosum*, and *metanocenchris jacquemontii*) and shrub (*Zizyphus mauritiana*). Roost counts made during 16<sup>th</sup> November 2004 and 10<sup>th</sup> February 2005 recorded a total of 73 and 36 harriers roosting respectively. It was observed that harriers held individual roost territories (c 1 m<sup>2</sup>) confirmed by number of pellets found at each roost site. However, at sites where ungulates (Blackbuck *Antelope cervicapra* and Nilgai *Boselaphus tragocamelus*) rested they were found more than one. The potential predators at the roosting area were Jungle Cat, Jackal, and Striped Hyena and Dusky Eagle Owl. Two dead ringtails completely eaten except wings were collected from the roost.

Table. 1. Salient features of various study sites holding communal harrier roosts in western and southern India during 1996-2005.

(Note: WLS = Wildlife Sanctuary, NP = National Park, RJ = Rajasthan, MH = Maharashtra, AP = Andhra Pradesh, KR = Karnataka)

| SN | Roost site                | State | Location<br>(Lat/Long) | Area<br>(Km <sup>2</sup> ) | MSL<br>(m) | Temp.<br>(°C) | Annual<br>rainfall<br>(mm) | Broad<br>habitat<br>types          | Major flora<br>(Dominant<br>trees)                                                                                                             | Major fauna<br>(Mainly<br>Mammal)                               | Surrounding matrix                                                                                                                                         |
|----|---------------------------|-------|------------------------|----------------------------|------------|---------------|----------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Tal Chhaper<br>WLS        | RJ    | 27°47' N<br>74° 25' E  | 7.9                        | 326        | 0.5-48        | 300                        | Grassland/<br>scrubland            | <i>Prosopis cineraria</i> ,<br><i>Salvadora oleoides</i> ,<br><i>Acacia nilotica</i> ,                                                         | Blackbuck<br><i>Antelope</i><br><i>cervicapra</i> ,<br>Fox sp.  | Agricultural land/ crops;<br>saltpansMain Bajra<br>or Pearl millet<br><i>Pennisetum typhoides</i> ,<br>wheat <i>Triticum aestivum</i> ,<br>pulses and gram |
| 2  | Keoladeo NP               | RJ    | 27° 12' N<br>77° 33' E | 29.0                       | 174        | 3.7-<br>48.5  | 600                        | Wetland/<br>woodland/<br>grassland | <i>Acacia nilotica</i> ,<br><i>Mitragyna parvifolia</i> ,<br><i>P. cineraria</i> ,<br><i>Ziziphus mauritiana</i> ,<br><i>Salvadora persica</i> | Spotted deer<br>Axis axis,<br>migratory<br>Waterfowls           | Agricultural landsMain<br>crops; wheat, Bajra, and<br>Mustard <i>Brasica</i><br><i>compastris</i>                                                          |
| 3  | Akola                     | MH    | 20° 43' N<br>77° 04' E | 5.0                        | 308        | 2.0-42.0      | 846                        | Grassland/<br>scrubland            | <i>Acacia catechu</i> ,<br><i>P. spicigera</i> ,<br><i>Z.mauritiana</i> ,<br><i>A. nilotica</i>                                                | Blackbuck,<br>Jungle Cat<br><i>Felis chaus</i>                  | Agricultural landsMain<br>crops; Cotton <i>Gossypium</i><br><i>hirsutum</i> , Jowar<br><i>Sorghum vulgare</i>                                              |
| 4  | Mumbai                    | MH    | 19° 01' N<br>72° 53' E | 1.0                        | 10         | 13-39         | 747                        | Grassland/<br>drainage             | <i>Avicennia marina</i>                                                                                                                        | Migratory<br>waterfowls                                         | Saltpans/coastal lagoon                                                                                                                                    |
| 5  | Rollapadu<br>WLS          | AP    | 15° 44' N<br>78° 22' E | 6.14                       | 279        | 19-44         | 630                        | Grassland/<br>scrubland            | <i>Casia fistula</i> ,<br><i>Azadirachta indica</i>                                                                                            | Blackbuck,<br>Indian Fox<br><i>Vulpes</i><br><i>bengalensis</i> | Agricultural landscotton,<br>groundnut <i>Arachis</i><br><i>hypogaea</i> castor <i>Ricinus</i><br><i>communis</i>                                          |
| 6  | ICRISAT,<br>Patancheru    | AP    | 17° 29' N<br>78° 15' E | 14                         | 337        | 13-39         | 800                        | Grassland/<br>scrubland            | <i>Acacia nilotica</i>                                                                                                                         | Jackal <i>Canis</i><br><i>aureus</i>                            | Bajra, Cotton, Jowar,<br>Pigeon Pea <i>Cajanus</i><br><i>cajan</i> , Rice <i>Oryza sativa</i>                                                              |
| 7  | Hesaraghata,<br>Bangalore | KR    | 13° 09' N<br>77° 28' E | 4.4                        | 890        | 14-32         | 800                        | Fodder<br>grassland/<br>scrubland  | Tamarind<br><i>Tamarindus indica</i> ,<br>Neem <i>Azadirachta</i><br><i>indica</i> ,                                                           | -                                                               | Agricultural land/<br>wetlandsMain crops;<br>Rice, Ragi <i>Eleusine</i><br><i>coracana</i> groundnut,<br>avare <i>Dolichos lablab</i>                      |
| 8  | Madiwala,<br>Bangalore    | KR    | 13°02'N<br>77°35'E     | 0.1                        | -          | 22-32         | 800                        | Wetland<br>with Water-<br>hyacinth | -                                                                                                                                              | -                                                               | Wetlands/agricultural<br>landRice,Ragi                                                                                                                     |

**Table. 2. Characteristics of various communal roost sites located in western and southern India during 1996-2005. (WLS= Wildlife Sanctuary, NP= National Park, UPA= Unprotected area, Aq. = Aquatic, WWH= With Water-hyacinth)**

| Roost site         | Legal status | Roost habitat              | Average height | Roosting population (Max.) | Distance to Water body (Average) | Distance to crop field (Average) | Distance to Human settlement (Average) |
|--------------------|--------------|----------------------------|----------------|----------------------------|----------------------------------|----------------------------------|----------------------------------------|
| Western India      |              |                            |                |                            |                                  |                                  |                                        |
| 1. Tal Chhaper WLS | PA           | Grassland                  | 0.40 m         | 43                         | 2.5 km                           | 2.0 km                           | 2.0 km                                 |
| 2. Keoladeo NP     | PA           | Grassland<br>Wetland (WWH) | 1.3 m<br>0.6 m | 132<br>35                  | 3.0 km<br>–                      | 0.5 km<br>1.0 km                 | 1.5 km<br>2.0 km                       |
| 3. Akola           | UPA          | Grassland                  | 1.7 m          | 77                         | 3.5 km                           | 0.1 Km                           | 4.0 km                                 |
| 4. Mumbai          | UPA          | Aq. grassland              | 1.0 m          | 49                         | 2.5 km                           | 8.0 km                           | 0.2 km                                 |
| Southern India     |              |                            |                |                            |                                  |                                  |                                        |
| 1. Rollapadu WLS   | PA           | Grassland                  | 0.6 m          | 48                         | 2.0 km                           | 0.5 km                           | 2.0 km                                 |
| 2. ICRISAT         | UPA          | Grassland                  | 1.1 m          | 136                        | 0.3 km                           | 0.5 km                           | 3.5 km                                 |
| 3. Hessarghata     | UPA          | Grassland                  | 1.0 m          | 111                        | 1.0 km                           | 2.5 km                           | 3.0 km                                 |
| 4. Madiwala        | PA           | Wetland (WWH)              | 0.5 m          | 31                         | –                                | 6.0 km                           | 1.5 km                                 |

At Mumbai, the exclusive roost of Eurasian Marsh harrier was located near Mahul creek on the east coast of Mumbai along the Arabian Sea in the premises of Rashtriya Chemical Factory Private Limited. Perennial aquatic grasses like *Paspalidium* sp, and *Paspalum* sp. formed the roost habitat. Harriers used mangrove trees like *Avicennia marina*, other trees and grasses as pre-roosting perches. During pre roost the vocalization was more prominent and most of the time female harriers vocalized at the sight of arrival of conspecifics. Three counts were made during 19<sup>th</sup> December 2003, 17<sup>th</sup> of October and 25<sup>th</sup> November 2004 which showed roosting population to be 50, 33 and 49 respectively. This is probably an indication to a stable population of harriers over the years.

### **Southern India**

At Rollapadu, harriers used bare grounds for pre roosting and large grasslands for roosting. They used Blackbuck rest sites for roosting also. On one

occasion, a gathering of 10 harriers chased away a fox trying to enter their roost area. Three counts were made during 29<sup>th</sup> March 2004 and 31<sup>st</sup> October and 1<sup>st</sup> November 2005. The harrier numbers at roost were found to be 47, 30 and 48 respectively. Probably the numbers increase from November onwards and by March declined gradually. Over 500 harriers have been recorded roosting here in late November and December (personal communication; Gaffur Ahmed). Three ringtails were found completely eaten with feathers left behind. The Indian Fox was a common predator sighted here evidenced by harrier feathers found at its den.

At ICRISAT, the harriers used a tall grassland dominated by mostly one type of grass species. On comparing roost habitat with a potential habitat it was found that harriers selected a grassland patch with soft textured grass and tall enough to conceal them away from plantation and human used paths. Though no significant difference was found in the height of

grasses both at the potential ( $142 \pm 61$  m) and roost site ( $\chi^2 = 0.054$ ,  $df = 1$ ,  $p > 0.05$ ) but the potential roost had coarse and sparsely distributed and at some places densely grown grasses. Few used trees as resting perch before roosting otherwise mostly perched on the ground. Few perched on electric poles just after leaving the roost in the morning. Except for 2-3 harriers all would leave the roost for foraging grounds. The roosting population recorded during 3<sup>rd</sup> November 2004 and 25<sup>th</sup> February 2005 was estimated to be 74 and 136 individuals respectively.

Two Marsh Harriers were found dead at the roost site. One was adult female with intact body and other was most probably a juvenile. Except for wings the juvenile had been completely eaten by a predator. The predators recorded were Jungle Cat and Jackal.

At Hesaraghata, the roost was located in fodder grassland dominated by *Chloris gayana* variety *Callide Kotembora* (commonly called Rhodes grass) (about 95%). There was a lake about half a kilometer towards its east called 'Hesaraghata Lake'. The roost was shifted number of times from one grassland to another due to disturbance caused by grass harvesting at the roost. Generally harriers arrived about 1-2 hours of roosting spending time sitting in the close vicinity of the roost on mostly bare open grounds and occasionally on trees. Vocalization was more prominent like it was recorded at roost in Mumbai. Both the sites were dominated by Eurasian Marsh harriers. Similarly, female harriers were more vocal here. Roosting population recorded during three counts during 2<sup>nd</sup> January, 6<sup>th</sup> January and 26<sup>th</sup> February 2005 were found to be 97, 111 and 70 individuals which is an indication of a healthy wintering population.

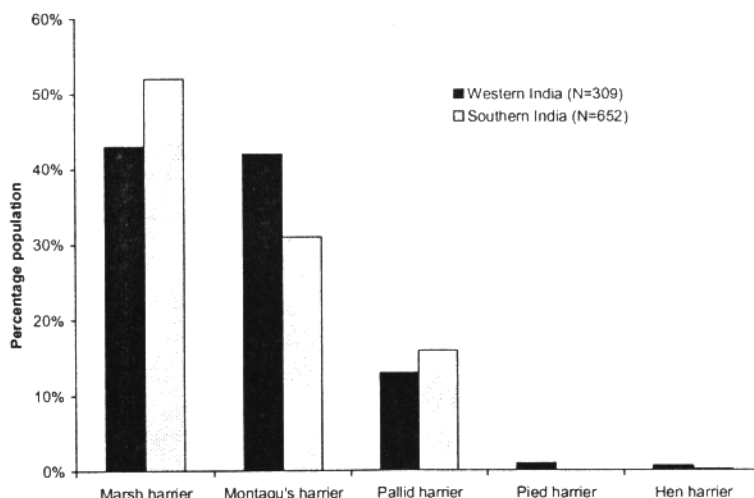
An exclusive roost of Eurasian Marsh Harriers was located from the Madiwala wetland, Bangalore. The Water-hyacinth that was dry at the top formed the roosting habitat for harriers where a maximum of 31 harriers were counted roosting on 1<sup>st</sup> March 05. The roost was all surrounded by human colonies.

The preliminary observations showed that Montagu's, Pied and Hen Harriers were sighted more frequently in western India than in southern India whereas Eurasian Marsh and Pallid Harriers were sighted more in southern India (Fig.1)

## Discussion

The harriers in their wintering ground in India were mostly found to be using tall grasslands for roosting. They roosted in undisturbed vast patches of grasslands generally lying close to water bodies. Of large open area, they used areas between 0.5 to 1.5 km<sup>2</sup> for roosting. Among various factors for roost habitat selection height of the vegetation seemed to be important as this would not only conceal them from predators but also provide them shelter from cold winds. The choice of the relatively sheltered roost sites may provide a favourable thermal environment or concealment from enemies and pests (Janes 1985). As harriers roost on ground the chances of their being predated by ground dwelling predators like Jungle Cat, Jackal, Fox and others become higher if they do not hide in the vegetation. With the increase in height of vegetation the ability of predators to detect prey gets reduced (Janes 1985). Nocturnal predators like owls which are birds of open habitats like grasslands could be one of potential predators for roosting harriers. Hence, the tall roost vegetation probably is helpful in their low detection by owls.

Fig. 1. Comparison of roosting harrier population between western and southern India during 2004-2005



There are incidences of owls hunting on raptors (Newton 1979).

The Eurasian Marsh Harriers are marsh dependent birds and their major diet comprise of waterfowls and other aquatic birds (Verma 2002). Availability of large number of open water bodies and paddy fields could attract large prey base for them in south India than western India and therefore a fairly large number of these harriers were reported from south India. The reason for high number of Montagu's Harriers in western India could be attributed to availability of more dry habitats where grasshoppers are found in abundance. The grasshoppers are known to form their staple diet in wintering grounds (Clarke 1996, Verma 2005). The reason for low sightings of Pied and Hen Harriers is that their distribution lies to the northeast and upper north India respectively and which could not be covered during the present survey. Also the Hen Harriers are believed to be the passage migrants to India (Ali and Ripley 1983).

The study has provided baseline information on harriers' roost habitat use which is a very critical resource for their survival in wintering ground. However, studies are required to understand their movements, population trends, foraging habitat requirements and other factors affecting them for formulating an effective conservation strategy for their long term survival in their wintering ground.

### **Conservation Issues**

1. The grasslands are fast disappearing from India and are one of the most threatened ecosystems in India (Biological diversity Act 2002). The rapid developmental activities and change in land use patterns to meet the demands of burgeoning human population is responsible for destroying harriers' habitat both foraging and roosting. Harriers require large open grasslands, scrub lands, wetlands as hunting grounds and largely grasslands for communal roosting in winter quarters in India. Reclamation of wetlands and conversion of grasslands to plantation and agriculture threatens very survival of harriers. It was found that within a span of about 10 years a roost with 200 harriers (Ganesh and Kanniah 2000) located at Alwal grasslands in Secunderabad, Andhra Pradesh had been completely deserted. It was noticed that plantation had encroached the larger part of earlier a grassland and many buildings had come up where there used to be paddy fields and barren grounds.

2. Grazing and harvesting of grasslands especially at roost sites are other serious concerns for harrier conservation in India. Since most of the grasslands and many small water bodies fall out side the protected area network and hence there is hardly any control over activities going on there. There is no policy as such existing targeted for harrier conservation in India. India is also known for possessing the greatest diversity of harriers post breeding in the world (Simmons 2000). What urgently required is to map distribution of grasslands in India and to provide stringent protection to them.
3. The mega projects involving construction of canals to provide irrigation facilities to the villagers also pass through roosting sites of harriers as for example Narmada canal in Velavadar National Park and Telugu Ganga canal in Rollapadu Wildlife Sanctuary threatens the survival of harriers in the region. These two roosting sites are the largest roosting habitat for harriers in India known so far.
4. Intensive use of pesticides for controlling crop pests including grasshoppers, and rodents is common practice in India. Use of pesticides in India is increasing at the rate of 2.5% per annum (Toxics Link 2000). Pesticides are known to cause deleterious effect on the breeding success of raptors (Crick and Ratcliff 1995). Harriers, being on the top of the food-chain are most vulnerable to the affects of pesticides through the process of bio-magnification in their food-chain. Hamerstrom (1969) considered pesticides a major factor responsible for a continuous decline (70%) in harrier population on spring migration at Wisconsin, acquired during foraging in wintering grounds. There has been no such study on pesticides effect on harrier's survival in India.

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# Biped Locomotion in Birds: An Evolutionary Conundrum

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## Introduction

Bipedalism, as a vehicle for individual mobility is a higher evolutionary attribute, the higher mammal, man alone, having successfully adapted and developed it into performance of a wide range of movements and function. Lower down the scale, however, one finds that avians too, had developed a bipedal gait for terrestrial sorties, but developed and fine-tuned their forelimbs into alae: flying was found a better safer option for locomotion, conferring birds with a wider range of easier movement. Birds alone, it is seen, are masters of movement through all three mediums, terrestrial, water and air. By conquering the three elements, birds hold a unique status in the faunal world.

Gait in birds, however, is not as uniformly developed, as in man. While some species exhibit a wide range of combinations using their legs, others are less adept. Waddling, walking, strutting and hopping, are common variations and preferences in bipedal locomotion in birds.

This brief paper analyzes some of factors that may influence the preferences in the choices for mobility among avifauna.

Our inference is that among the factors that determine mode of bipedal locomotion, range and articular bio-mechanisms of the cervical joints is significant.

## Materials & Methods

Field observations on some common species found in urban habitats formed the data base. A three-month observation was mounted on locomotion – kinetics in common city birds such as common crows (*C. splendens*), sparrows (*P. domesticus*), magpie robins (*C. saularis*), blue rock pigeons (*C. livia*), black kites (*M. migrans*), Brahminy kites (*H. Indus*), green barbets (*M. zeylanica*), common mynas (*A. tristis*) pond herons (*A. grayi*), egrets (*B. ibis*) and barn owls (*T. alba*). Video recordings of terrestrial and arboreal ambulatory mechanisms in peafowl were also used.

The range, spin, pivot and rotation of the bird cervix (neck) region among various species were noted to an approximate degree. The collated information was

evaluated against any advantage, or limitation, in terms of visual field and periphery in each species.

## Inferences

- a) Raptors (kites, owls and their ilk) or such other birds hop and strut less than their arboreal and more terrestrial cousins, the passerines.
- b) Arboreal and ground, or low flying birds hop and walk much more than the hi-fliers or nocturnal cousins
- c) Birds that are endowed with a better degree of rotation of their neck vertebrae, hop less. That is, birds that are limited in their swivel of neck to 180 degree or less, can hop more efficiently and more often than the birds that can rotate their heads to much wider arc. Owls, kites are gifted with nearly 300 degree range of side to side swivel of neck vertebra. In anatomical terms, the inter-vertebral cervical joints have wider articular surfaces of the plane / condylar type in birds that soar, or hover, or nocturnal. These birds, hypothetically at least, being gifted with a wider eye view thanks to a more efficient cervical mobility, find less need to hop, twist and turn their whole bodies using their feet and other lower limb joints.
- d) The natural processes of adaptation has perhaps given birds that strut and hop less with better cervical articular vertebral inputs, and vice versa, birds that can better hop, jump, strut and perch need less efficiency in the head mobility. Of course the range and axis of movement of the cervical inter-vertebral joints aiding in increasing or diminishing range of field of vision.

## Discussion

Various theories and hypotheses have been proposed over the years on the bio-mechanics and kinetics of bipedal locomotion in birds. The plesiosaur and sauropod dinosaurs had 30 to 50 neck bones. From the archaeopteryx and the quadruped pterodactyls of the Jurassic age, with modified forelimbs as adjuncts to flight, to the highly efficient winged soar and flight, birds have, as an alternate option, dropped and relegated terrestrial two-limbed bipedal locomotion

to secondary importance. Flight promises far more speed, safety and succor than rear limb propulsion. However this mode of locomotion has not been abandoned: smaller birds and passerines, preferential terrestrials, still opt for two limbed strut as effective aid of forage, nesting and roosting.

Several vertebrae are fused except for those in the neck region. The number of neck vertebrae for birds in general varies from 15 or fewer in small birds with short necks to 20 or more in large birds with long necks. More neck vertebrae imply increased mobility of the head and neck. Birds have more neck (cervical) vertebrae than many other animals; most have 13 to 25.

Earlier research demonstrates that neck mobility is an useful adjunct to preening, in our view that the capability may endow far greater advantage to range and breadth of vision. Any bird with an almost 360 degree visual attribute, has far greater chance to spot danger or prey than one without. Such birds have lesser requirement to hop back or forth, side to side or turn around. Birds endowed with less number of cervical vertebrae are perforce required to shift body position completely for increasing range of vision. This constant mandate to shift position abruptly engenders two-legged hopping as a substitute to bipedal walking.

In our observation, bird hopping is directly related to number of neck vertebra cervical mobility, the range of articulation of the inter-vertebral joints, confers another natural spin-off, wider range vision. It would not be too fanciful to conclude that the dynamics of bird gait are to a large extent determined by the optometric scope of the visual field required, and that the perimeter of vision is directly related to the number of neck vertebrae in a given species.

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# Conservation of Wetlands of Kerala with Special Reference to Ramsar sites

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## Introduction

The ornithological studies on wetlands of Kerala commenced after Neelakantan's extensive explorations of the water bodies in the State, which were greatly rewarding (Neelakantan, 1969a; 1969b; 1970; 1981; 1982; Neelakantan *et al.*, 1980; Neelakantan and Sureshkumar, 1980). Uthaman and Namassivayan (1991) had carried out an intensive study on the birdlife at Kadalundi estuary. That study also had come out with many interesting observations (Namassivayan *et al.*, 1989; Namassivayan and Venugopal, 1989; Uthaman, 1990; Uthaman and Namassivayan (1992). Recently couple of detailed ecological studies on the birds of wetlands of the state was carried out at Bharatapuzha estuary and Malabar Coast (Kurup, 1987, 1990 and 1991, 1996) and at Kole wetlands (Jayson and Sivaperuman, 1999 and Jayson, 2002), and Jayson and Easa (2000). Sashikumar (1989, 1990, and 1991) and Sashikumar *et al.* (1991) reported the occurrence of many new species from the wetlands of Kerala.

Studies on the waterfowl of the Kerala State got an impetus after the inception of the Asian Waterfowl Census (AWC) in 1987. The Kole Wetlands and Vembanad Lake (Ramsar sites, since 2002) were practically unknown to the birdwatchers before the inception of Asian Waterfowl Census. Comprehensive bird surveys were carried out as part of the AWC at Kole wetlands for three consecutive years from 1992 to 1994 (Nameer, 1992b; 1993a, 1993b, 1994a, 2002a, 2002b, and 2005) and at Vembanad lake during 1993 (Nameer, 1993c) then from 2001 to 2004 (Sreekumar, 2001, 2002, 2003, 2004 and 2005).

## Study Area

- a. **Kole wetlands:** The Kole Wetlands covering an area of 13,632 ha are spread over Thrissur and Malappuram districts extending from the northern bank of Chalakudy river in the South to the southern bank of Bharathapuzha river in the North. The area lies between 10°20' and

10°40'N latitudes and 75°58' and 76°11'E longitudes.

- b. **Vembanad Lake:** Vembanad Lake is spread over Ernakulam, Alleppey and Kottayam district, is located between 9°17' and 9°40' N latitude and 76°19' and 76°33' E longitude. It covers a total area of 79, 400 ha.

## Methods

Data collected as part of the Asian Waterfowl Census from 1991 to 2002 (Perennou & Mundkur, 1991 and 1992, Mundkur and Taylor, 1993, Nameer, 1992b, 1993c, 1994b, 1995a, 1996a, 1997, 1998a, 1999, 2000, 2001 and 2002a) and the organised surveys conducted during 1992 to 1994 and 2005 at Kole wetlands (Nameer, 1992a; 1993a, 1994a and 2005) and 1993, 2001 and 2002 (Nameer, 1993b; Sreekumar, 2001 to 2005) at Vembanad lake are summarised here.

Apart from the ornithological investigations, a socio-economic survey was conducted at Kole wetlands during 1998. A sample population of 500 people living in and around the Kole wetlands was surveyed. Under four occupational categories such as Agriculture, Fisheries, Poultry and Animal Husbandry. Separate data sheets were prepared for each profession. The survey was intended for finding out the extent of dependence of the human on Kole and the income that is generated from Kole wetlands by the various land use activities.

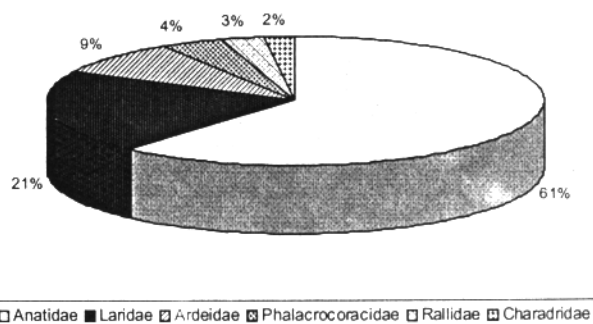
## Results

- a. **Birds of Kole wetlands:** A total of 233 species of birds in 60 families have been reported from Kole wetlands. Out of this 88 species (37.77%) are long distant migrants. Ninety six species of water birds (in 17 families) and eight migratory raptors have so far been recorded from Kole Wetlands. Regarding the water birds about 61% of the birds counted from Kole Wetlands belong to Anatidae (six species) followed by Laridae (21%; 14 species) and Ardeidae (8.5 %; 14 species). This is followed by Phalacrocoracidae

(4.1) and Rallidae (2.6%). Charadriidae and Scolopacidae though have more number of species (12 and 22 species respectively) it accounts for only 1.9 % of total number of birds. Podicipididae, Pelicanidae, Ciconidae, Threskiorinthidae, Jacanidae, Recurvirostridae and Glareolidae accounts for the rest 2% (Fig.1).

Little Cormorant (*Phalacrocorax niger*), Pond Heron (*Ardeola grayii*), Cattle Egret (*Bubulcus ibis*), Little

Fig.1 Family-wise distribution of birds of Kole wetlands



Egret (*Egretta garzetta*), Red-wattled Lapwing (*Vanellus indicus*), Kentish Plover (*Charadrius alexandrinus*), Spotted Sandpiper (*Tringa glareola*), Green Sandpiper (*Tringa ochropus*), Common Sandpiper (*Actitis hypoleucos*), Little Stint (*Calidris minuta*), Temminck's Stint (*Calidris temminckii*), Brownheaded Gull (*Larus brunnicephalus*), Blackheaded Gull (*Larus ridibundus*) and Whiskered Tern (*Chlidonias hybrida*) have been recorded during all the years in the study period and could be considered as the commonest water birds in the area.

Out of the total of 233 species, recorded from Kole Wetlands, 24 species are not included in 'Birds of Kerala' (Ali, 1969), among which ten are first reports from Kerala. (Table 1).

Table 1. List of birds sighted from Kole Wetlands that is not included in 'Birds of Kerala' (Ali, 1969)

| Sl. # | Common Name           | Scientific Name               |
|-------|-----------------------|-------------------------------|
| 1. *  | Greater Spotted Eagle | <i>Aquila clanga</i>          |
| 2.    | Masked Booby          | <i>Sula dactylatra</i>        |
| 3. *  | Great Bittern         | <i>Botaurus stellaris</i>     |
| 4.    | White Stork           | <i>Ciconia ciconia</i>        |
| 5. *  | Spoonbill             | <i>Platalea leucorodia</i>    |
| 6.    | Pintail Duck          | <i>Anas acuta</i>             |
| 7. *  | Comb Duck             | <i>Sarkidiornis melanotos</i> |
| 8.    | Coot                  | <i>Fulica atra</i>            |
| 9.    | Black-winged Stilt    | <i>Himantopus himantopus</i>  |
| 10.   | Oriental Pratincole   | <i>Glareola maldivarum</i>    |
| 11.   | Grey Plover           | <i>Pluvialis squatarola</i>   |
| 12. * | White-tailed Lapwing  | <i>Vanellus leucurus</i>      |
| 13. * | Grey-headed Lapwing   | <i>Vanellus cinereus</i>      |
| 14.   | Ringed Plover         | <i>Charadrius hiaticula</i>   |
| 15.   | Temminck's Stint      | <i>Calidris temminckii</i>    |
| 16.   | Sanderling            | <i>Calidris alba</i>          |
| 17. * | Little Tern           | <i>Sterna albifrons</i>       |
| 18.   | Sandwich Tern         | <i>Sterna sandvicensis</i>    |
| 19. * | Plain Sand Martin     | <i>Riparia paludicola</i>     |
| 20. * | Starling              | <i>Sturnus vulgaris</i>       |
| 21.   | Desert Wheatear       | <i>Oenanthe deserti</i>       |
| 22.   | Black Redstart        | <i>Phoenicurus ochruros</i>   |
| 23.   | Yellow-headed Wagtail | <i>Motacilla citreola</i>     |
| 24. * | Red Munia             | <i>Estrilda amandava</i>      |

\* Recorded from Kerala for the first time from Kole Wetlands. Other species have been sighted from other parts of Kerala (Neelakantan *et al.*, 1993).

Out of the 128 species of birds that are threatened with extinction, (Birdlife International, 2001) 31(24.22%) are present in Kerala. Out of the 31 species, 12 are wetland dependent species. Of which nine (75%) are seen in Kole wetlands. Red Data book species that are sighted from Kole wetlands are given in Table 2.

Table 2. Red data book species recorded from Kole wetlands

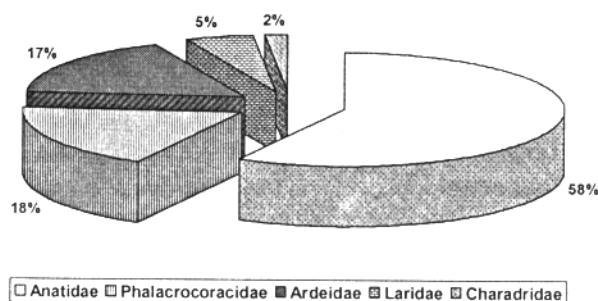
| Sl. # | Common Name           | Scientific Name                    | Status |
|-------|-----------------------|------------------------------------|--------|
| 1.    | Spot-billed Pelican   | <i>Pelecanus philippensis</i>      | VU     |
| 2.    | Oriental Darter       | <i>Anhinga melanogaster</i>        | NT     |
| 3.    | Black-headed Ibis     | <i>Threskiornis melanocephalus</i> | NT     |
| 4.    | Painted Stork         | <i>Mycteria leucocephala</i>       | NT     |
| 5.    | Wood Snipe            | <i>Gallinago nemoricola</i>        | VU     |
| 6.    | Great Snipe           | <i>Gallinago media</i>             | NT     |
| 7.    | Black-bellied Tern    | <i>Sterna acuticauda</i>           | NT     |
| 8.    | Pallid (Pale)Harrier  | <i>Circus macrourus</i>            | NT     |
| 9.    | Greater Spotted Eagle | <i>Aquila clanga</i>               | VU     |

Legend: VU – vulnerable; NT – near threatened

Apart from these wetland dependant species there was a single record of Cinereous Vulture *Aegypius monachus* from Kole wetlands during 1992, which is a Near Threatened species.

**b. Birds of Vembanad Lake:** A total of 185 species of birds in 57 families have been reported from Vembanad Lake. Out of this 52 species (28.11%) are long distant migrants. Seventy species of water birds (in 16 families) and three migratory raptors have so far been recorded from Vembanad Lake. Regarding the water birds about 57% of the birds counted from Vembanad Lake belong to Anatidae (seven species) followed by Phalacrocoracidae (18.18%; three species) and Ardeidae (16.75 %; 13 species). This is followed by Laridae (5.1) and Charadriidae (1.6%). Podicipididae, Pelicanidae, Ciconidae,

Fig. 2 Family-wise distribution of birds of Vembanad Lake



Threskiorinthidae, Jacanidae, Recurvirostridae and Glareolidae accounts for the rest 1.37% (Fig.2).

Little Cormorant (*Phalacrocorax niger*), Pond Heron (*Ardeola grayii*), Cattle Egret (*Bubulcus ibis*), Little Egret (*Egretta garzetta*) and Whiskered Tern (*Chlidonias hybrida*) have been recorded during all the years in the study period and could be considered as the commonest water birds in Vembanad.

Out of the total of 185 species, recorded from Vembanad Lake, six species are not included in 'Birds of Kerala' (Ali, 1969), among which Steppe Eagle is the first report from Kerala. (Table 3).

**Table 3. List of birds sighted from Vembanad Lake that is not included in 'Birds of Kerala' (Ali, 1969)**

| Sl. | Common Name        | Scientific Name              |
|-----|--------------------|------------------------------|
| 1.  | * Steppe Eagle     | <i>Aquila nipalensis</i>     |
| 2.  | White Stork        | <i>Ciconia ciconia</i>       |
| 3.  | Pintail Duck       | <i>Anas acuta</i>            |
| 4.  | Coot               | <i>Fulica atra</i>           |
| 5.  | Black-winged Stilt | <i>Himantopus himantopus</i> |
| 6.  | Temminck's Stint   | <i>Calidris temminckii</i>   |

\* Recorded from Kerala for the first time from Vembanad Lake. Other species have been sighted from other parts of Kerala (Neelakantan *et al.*, 1993).

Out of the 128 species of birds that are threatened with extinction, (Birdlife International, 2001) 31(24.22%) are present in Kerala. Out of the 31 species, 12 are wetland dependent species. Of which four (3.33%) are seen in Vembanad Lake. Red Data book species that are sighted from Vembanad Lake are given in Table 4.

Legend: VU – vulnerable; NT – near threatened

### c. Socio-economic value of Kole wetlands

**Agriculture:** Agriculture is the major occupation of the people of Kole. 90% of the people surveyed were practicing agriculture, mostly paddy. It is estimated that from one ha. one farmer makes a profit of Rs. 20,663.90 and one hectare land generate 160 man days of employment annually.

Assuming that 7500 ha. (~ 50% of total wetland area) of the Kole wetlands is being cultivated under rice in a year, the total man-days of job generated from Kole lands through agriculture practice would be 12,00,000 (160 x 7500) and the profit made from the 7500 ha. Kole lands would be around Rs.15,49,79,250 (Rs. 20,663.90 x 7500).

**Fisheries:** Fishing though carried out most of the time in a year, intensive fishing operation is carried out only during three months. It is estimated that around 500 persons are directly involved in fishery activities at Kole wetlands. Thus fisheries generate 45,000 man-days (500 persons x 90 days) of work in a year from Kole wetlands. It is estimated that one person makes a profit of about Rs.137.50 in a day. Hence the total income generated from the Kole wetlands from fishery activity is Rs.61,87,500 (500 x 90 x Rs.137.50) in one year.

**Poultry:** This mainly involves the rearing of the ducks. The Kole area after cultivation is leased out for rearing ducks. The ducks are brought from the neighboring States also. One duck gives a profit of Rs.400 during one season. Assuming that there would be 10,000 ducks being reared at Kole wetlands in one season the poultry rearing would generate an income of Rs. 40,00,000 in one season from Kole. Four male labourers are involved in looking after 1000 ducks. Hence for rearing 10000 ducks 40 male labourers are involved. The duck rearing operation lasts for about three months, and thus generate 3600 (40 men x 90 days) man-days of work during one season.

**Animal Husbandry:** Majority of the farmers of Kole lands keep one to two cows, to meet their milk and milk products requirement. The excess milk is either

Table 4. Red data book species recorded from Vembanad Lake

| Sl. # | Common Name         | Scientific Name                    | Status |
|-------|---------------------|------------------------------------|--------|
| 1.    | Spot-billed Pelican | <i>Pelecanus philippensis</i>      | VU     |
| 2.    | Oriental Darter     | <i>Anhinga melanogaster</i> ,      | NT     |
| 3.    | Black-headed Ibis   | <i>Threskiornis melanocephalus</i> | NT     |
| 4.    | Ferruginous Pochard | <i>Aythya nyroca</i>               | NT     |

sold to the societies or to individuals. It is estimated that the Animal Husbandry provides an income of Rs. 1559 per cow. Assuming that the farmers in and around Kole lands are rearing 5000 cows, the Animal Husbandry would generate an income of Rs. 77,95,000.

Hence altogether from the four different forms of land use patterns that is in vogue in Kole wetlands, a total of 12,49,100 man-days of job is being generated from Kole wetlands, and the same generates an income to the tune of Rs. 17,29,61,750. The details regarding the land use pattern, number of man-days and the income generated from the same is given in Table 5.

**Discussion:** Until 2002 India had only six Ramsar site such as Keoladeo National Park, Rajasthan; Chilika Lake, Orissa; Harike Lake, Punjab; Loktak Lake, Manipur; Sambhar Lake, Rajasthan; Wular Lake, Jammu & Kashmir. During 2002 13 more wetlands of the country were designated as Ramsar Sites. They are Tsomoriri, Jammu & Kashmir; Pong Dam Lake, Himachal Pradesh; Kanjli, Punjab; Ropar, Punjab; Deepor Beel, Assam; East Calcutta Wetlands, West Bengal; Bhitarkanika Mangroves, Orissa; Bhoj Wetland, Madhya Pradesh; Kolleru Lake, Andhra Pradesh; Point Calimere Sanctuary, Tamil Nadu; Sasthamkotta Lake, Kerala; Ashtamudi Lake, Kerala; and Vembanad-Kole Wetland, Kerala (www.ramsar.org 2003). Out of the 13 recently declared Ramsar sites of the country three are in Kerala and Vembanad-Kole wetland complex is one among them. For a wetland to be declared as a Ramsar Site, a series criteria need to be fulfilled. Among which the two quantitative criteria are a). any wetland that regularly support 20,000 + water birds and b). any wetland that regularly support more than

1% of the worlds population of any one species of water birds. Kole wetlands and Vembanad have been fulfilling both there criteria for more than last ten years (Nameer, 1993d; 1995b; 1998b; 2002b and 2002c).

Vembanad-Kole wetland complex is also the second largest wetland in the country after Chilika Lake in Orissa in terms of the number of birds. Vembanad-Kole wetland complex has been supporting nearly one lakh individuals of birds. Apart from this Vembanad-Kole wetland complex abode thousands of migratory waterfowl that come from far of places, even crossing the international borders. The results also clearly indicate the presence of several Red Data book birds (Table 2, Table 4) that are threatened with extinction in the Vembanad-Kole wetland complex. The socio-economic value that was worked out for the Kole wetlands part of the Vembanad-Kole wetland complex indicate that the Kole wetlands generate about 12.49 lakhs of man days in a single year, which in turn makes a profit to the tune of Rs. 17.30 crores (Table 5). This is a very conservative estimation of the socio-economic value of the Kole wetlands. The socio-economic value for the Vembanad Lake, if worked out, would not be much different from that of Kole wetlands.

Though the Vembanad-Kole wetland complex is such a valuable ecosystem from ecological, environmental, biodiversity and socio-economic point of view and in spite of the international recognition that these unique wetland complex recently attained, it is one of the most endangered ecosystem in the State. Reclamation of wetland and change in land use pattern are the most serious problems. The paddy fields are being converted to coconut, areca nut, and banana plantations and other cash crops at an

Table 5. Land use pattern, number of man-days and income generated from Kole lands in a year

| Sl.# | Land use         | # man days generated           | Income (Rs.)                       |
|------|------------------|--------------------------------|------------------------------------|
| 1.   | Agriculture      | 12,00,000 (160 x 7500 ha.)     | 15,49,79,250                       |
| 2.   | Fisheries        | 45,000 (500 x 90 days)         | 61,87,500                          |
| 3.   | Poultry          | 3600 (40 x 90 days)            | 40,00,000                          |
| 4.   | Animal Husbandry | 500                            | 77,95,000                          |
|      |                  | <b>12,49,100 (12.49 lakhs)</b> | <b>17,29,61,750 (17.30 Crores)</b> |



alarming rate. The marshes are being 'developed' and new constructions are cropping up. At many places the wetland has been converted to brick kilns, which has become a profitable small scale industry. The indiscriminate use of pesticides has been found to affect the migrant bird population which visits Kerala wetlands from September to April every year. The pesticides besides affecting the birdlife indirectly were also found used to poison and capture birds for meat purpose. Apart from this, setting fire to the natural vegetation in the area adversely affects the breeding habitats of Ardeidae, Rallidae, Sylviinae, Ploceinae and Estrildinae members. Heavy poaching of the water birds, including the migratory birds and threatened species continue unabated.

### Recommendation

Kerala though has 14 protected areas, does not have a sanctuary that conserves the wetland habitat. Global biodiversity strategy (1992) emphasizes the inclusion of two or more large sample of each of the biogeographic zones in a region under the protected

area network in a region. Wetlands have been recognised worldwide as extremely important biogeographic zones.

Taking in to account the uniqueness and importance of the Vembanad-Kole wetland complex and also the threats that is being faced by this wetland complex, the State government is requested to take immediate steps to procure and then declare at least representative parts in the Vembanad-Kole wetland complex as a protected area.

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### Appendix I - Checklist of Birds of Vembanad - Kole Wetlands

| Family / Common Name               | Scientific name                                 | Vem | Kole | Status banad |
|------------------------------------|-------------------------------------------------|-----|------|--------------|
| <b>I. PODICIPEDIDAE</b>            |                                                 |     |      |              |
| 1. Little Grebe (5)                | <i>Tachybaptus ruficollis</i> (Pallas, 1764)    | +   | +    | R            |
| <b>II. PELECANIDAE</b>             |                                                 |     |      |              |
| 2. Spot-billed Pelican (21)        | <i>Pelecanus philippensis</i> Gmelin, 1789      | +   | +    | R, VU        |
| <b>III. SULIDAE</b>                |                                                 |     |      |              |
| 3. Masked Booby (23)               | <i>Sula dactylatra</i> Lesson, 1831             | -   | +    | V            |
| <b>IV. PHALACROCORACIDAE</b>       |                                                 |     |      |              |
| 4. Little Cormorant (28)           | <i>Phalacrocorax niger</i> (Vieillot, 1817)     | +   | +    | R            |
| 5. Indian Shag (27)                | <i>Phalacrocorax fuscicollis</i> Stephens, 1826 | +   | +    | R            |
| 6. Great Cormorant (26)            | <i>Phalacrocorax carbo</i> (Linnaeus, 1758)     | +   | +    | R            |
| <b>V. ANHINGIDAE</b>               |                                                 |     |      |              |
| 7. Darter (29)                     | <i>Anhinga melanogaster</i> Pennant, 1769       | +   | +    | R, NT        |
| <b>VI. ARDEIDAE</b>                |                                                 |     |      |              |
| 8. Little Egret (49)               | <i>Egretta garzetta</i> (Linnaeus, 1766)        | +   | +    | R            |
| 9. Western Reef-Egret (50)         | <i>Egretta gularis</i> (Bosc, 1792)             | +   | +    | R            |
| 10. Grey Heron (35-36)             | <i>Ardea cinerea</i> Linnaeus, 1758             | +   | +    | R            |
| 11. Purple Heron (37-37a)          | <i>Ardea purpurea</i> Linnaeus, 1766            | +   | +    | R            |
| 12. Large Egret (45-46)            | <i>Casmerodius albus</i> (Linnaeus, 1758)       | +   | +    | R            |
| 13. Median Egret (47,48)           | <i>Mesophoyx intermedia</i> (Wagler, 1829)      | +   | +    | R            |
| 14. Cattle Egret (44)              | <i>Bubulcus ibis</i> (Linnaeus, 1758)           | +   | +    | R            |
| 15. Indian Pond-Heron (42-42a)     | <i>Ardeola grayii</i> (Sykes, 1832)             | +   | +    | R            |
| 16. Little Green Heron (38-41)     | <i>Butorides striatus</i> (Linnaeus, 1758)      | +   | +    | R            |
| 17. Black-crowned Night-Heron (52) | <i>Nycticorax nycticorax</i> (Linnaeus, 1758)   | +   | +    | R            |
| 18. Yellow Bittern (57)            | <i>Ixobrychus sinensis</i> (Gmelin, 1789)       | +   | +    | R            |
| 19. Chestnut Bittern (56)          | <i>Ixobrychus cinnamomeus</i> (Gmelin, 1789)    | +   | +    | R            |

| Family / Common Name                         | Scientific name                                      | Vem | Kole | Status banad |
|----------------------------------------------|------------------------------------------------------|-----|------|--------------|
| 20. Black Bittern (58)                       | <i>Dupetor flavicollis</i> (Latham, 1790)            | +   | +    | R            |
| 21. Great Bittern (59)                       | <i>Botaurus stellaris</i> (Linnaeus, 1758)           | -   | +    | M            |
| <b>VII. CICONIIDAE</b>                       |                                                      |     |      |              |
| 22. Painted Stork (60)                       | <i>Mycteria leucocephala</i> (Pennant, 1769)         | -   | +    | R, NT        |
| 23. Asian Openbill-Stork (61)                | <i>Anastomus oscitans</i> (Boddaert, 1783)           | +   | +    | R            |
| 24. Black Stork (65)                         | <i>Ciconia nigra</i> (Linnaeus, 1758)                | -   | +    | M            |
| 25. White-necked Stork (62)                  | <i>Ciconia episcopus</i> (Boddaert, 1783)            | +   | +    | M            |
| 26. European White Stork (63)                | <i>Ciconia ciconia</i> (Linnaeus, 1758)              | -   | +    | M            |
| <b>VIII. THRESKIORNITHIDAE</b>               |                                                      |     |      |              |
| 27. Glossy Ibis (71)                         | <i>Plegadis falcinellus</i> (Linnaeus, 1766)         | +   | +    | R            |
| 28. Oriental White Ibis (69)                 | <i>Threskiornis melanocephalus</i> (Latham, 1790)    | +   | +    | R, NT        |
| 29. Black Ibis (70)                          | <i>Pseudibis papillosa</i> (Temminck, 1824)          | -   | +    | M            |
| 30. Eurasian Spoonbill (72)                  | <i>Platalea leucorodia</i> Linnaeus, 1758            | +   | +    | M            |
| <b>IX. ANATIDAE</b>                          |                                                      |     |      |              |
| 31. Lesser Whistling-Duck (88)               | <i>Dendrocygna javanica</i> (Horsfield, 1821)        | +   | +    | R            |
| 32. Comb Duck (115)                          | <i>Sarkidiornis melanotos</i> (Pennant, 1769)        | -   | +    | R            |
| 33. Cotton Teal (114)                        | <i>Nettapus coromandelianus</i> (Gmelin, 1789)       | +   | +    | R            |
| 34. Spot-billed Duck (97-99)                 | <i>Anas poecilorhyncha</i> J .R. Forester, 1781      | +   | +    | R            |
| 35. Northern Pintail (93)                    | <i>Anas acuta</i> Linnaeus, 1758                     | +   | +    | M            |
| 36. Gargany (104)                            | <i>Anas querquedula</i> Linnaeus, 1758               | +   | +    | M            |
| 37. Common Teal (94)                         | <i>Anas crecca</i> Linnaeus, 1758                    | -   | +    | M            |
| 38. Ferruginous Pochard (109)                | <i>Aythya nyroca</i> (Guldenstadt, 1770)             | -   | +    | M, NT        |
| <b>X. ACCIPITRIDAE</b>                       |                                                      |     |      |              |
| 39. Oriental Honey-Buzzard (129-130)         | <i>Pernis ptilorhynchus</i> (Temminck, 1821)         | -   | +    | R            |
| 40. Black-shouldered Kite (124)              | <i>Elanus caeruleus</i> (Desfontaines, 1789)         | +   | +    | R            |
| 41. Black Kite (132-134)                     | <i>Milvus migrans</i> (Boddaert, 1783)               | +   | +    | R            |
| 42. Brahminy Kite (135)                      | <i>Haliastur indus</i> (Boddaert, 1783)              | +   | +    | R            |
| 43. Cinereous Vulture (179)                  | <i>Aegypius monachus</i> (Linnaeus, 1766)            | -   | +    | V, NT        |
| 44. Crested Serpent-Eagle (196-200)          | <i>Spilornis cheela</i> (Latham, 1790)               | -   | +    | R            |
| 45. Hen Harrier (189)                        | <i>Circus cyaneus</i> (Linnaeus, 1766)               | -   | +    | M            |
| 46. Pied Harrier (192)                       | <i>Circus melanoleucos</i> (Pennant, 1769)           | -   | +    | M            |
| 47. Pallid (Pale) Harrier (190)              | <i>Circus macrourus</i> (S.G. Gmelin, 1770)          | -   | +    | M, NT        |
| 48. Western Marsh Harrier (193)              | <i>Circus aeruginosus</i> (Linnaeus, 1758)           | +   | +    | M            |
| 49. Shikra (137-140)                         | <i>Accipiter badius</i> (Gmelin, 1788)               | +   | +    | R            |
| 50. Eurasian Sparrowhawk (147-148)           | <i>Accipiter nisus</i> (Linnaeus, 1758)              | -   | +    | M            |
| 51. Greater Spotted Eagle (170)              | <i>Aquila clanga</i> Pallas, 1811                    | -   | +    | M, VU        |
| 52. Booted Eagle (164)                       | <i>Hieraaetus pennatus</i> (Gmelin, 1788)            | -   | +    | M            |
| 53. Changeable Hawk-Eagle (160-162)          | <i>Spizaetus cirrhatus</i> (Gmelin, 1788)            | -   | +    | R            |
| 54. Greater Grey-headed Fish-Eagle (175-176) | NT <i>Ichthyophaga ichthyaetus</i> (Horsfield, 1821) | +   | -    | R            |
| 55. Steppe Eagle (169)                       | <i>Aquila nipalensis</i> Hodgson, 1833               | +   | -    | M            |
| <b>XI. PANDIONIDAE</b>                       |                                                      |     |      |              |
| 56. Osprey (203)                             | <i>Pandion haliaetus</i> (Linnaeus, 1758)            | +   | +    | M            |
| <b>XII. FALCONIDAE</b>                       |                                                      |     |      |              |
| 57. Common Kestrel (222-224)                 | <i>Falco tinnunculus</i> Linnaeus, 1758              | +   | +    | R            |
| 58. Peregrine Falcon (209-211)               | <i>Falco peregrinus</i> Tunstall, 1771               | +   | +    | R            |
| <b>XIII. PHASIANIDAE</b>                     |                                                      |     |      |              |
| 59. Grey Francolin (244-246)                 | <i>Francolinus pondicerianus</i> (Gmelin, 1789)      | -   | +    | R            |
| 60. Rock Bush-Quail (259-261)                | <i>Perdica argoondah</i> (Sykes, 1832)               | -   | +    | R            |

| Family / Common Name                       | Scientific name                                 | Vem | Kole | Status banad |
|--------------------------------------------|-------------------------------------------------|-----|------|--------------|
| <b>XIV. RALLIDAE</b>                       |                                                 |     |      |              |
| 61. White-breasted Waterhen (343-345)      | <i>Amaurornis phoenicurus</i> (Pennant, 1769)   | +   | +    | R            |
| 62. Slaty-legged Crake (332)               | <i>Rallina eurizonoides</i> (Lafresnaye, 1845)  | -   | +    | R            |
| 63. Blue-breasted Rail (329-330)           | <i>Gallirallus striatus</i> Linnaeus, 1766      | -   | +    | R            |
| 64. Baillon's Crake (337)                  | <i>Porzana pusilla</i> (Pallas, 1776)           | -   | +    | M            |
| 65. Ruddy-breasted Crake (339-340)         | <i>Porzana fusca</i> (Linnaeus, 1766)           | +   | +    | R            |
| 66. Watercock (346)                        | <i>Gallixrex cinerea</i> (Gmelin, 1789)         | +   | +    | R            |
| 67. Purple Moorhen (348-349)               | <i>Porphyria porphyria</i> (Linnaeus, 1758)     | +   | +    | R            |
| 68. Common Moorhen (347-347a)              | <i>Gallinula chloropus</i> (Linnaeus, 1758)     | +   | +    | M            |
| 69. Common Coot (350)                      | <i>Fulica atra</i> Linnaeus, 1758               | +   | +    | M            |
| <b>XV. JACANIDAE</b>                       |                                                 |     |      |              |
| 70. Pheasant-tailed Jacana (358)           | <i>Hydrophasianus chirurgus</i> (Scopoli, 1786) | +   | +    | R            |
| 71. Bronze-winged Jacana (359)             | <i>Metopidius indicus</i> (Latham, 1790)        | +   | +    | R            |
| <b>XVI. ROSTRATULIDAE</b>                  |                                                 |     |      |              |
| 72. Greater Painted Snipe (Linnaeus, 1758) | <i>Rostratula benghalensis</i>                  | +   | -    | R            |
| <b>XVII. CHARADRIIDAE</b>                  |                                                 |     |      |              |
| 73. Pacific Golden-Plover (373)            | <i>Pluvialis fulva</i> (Gmelin, 1789)           | +   | +    | M            |
| 74. Grey Plover (371)                      | <i>Pluvialis squatarola</i> (Linnaeus, 1758)    | -   | +    | M            |
| 75. Common Ringed Plover (378)             | <i>Charadrius hiaticula</i> Linnaeus, 1758      | -   | +    | M            |
| 76. Little Ringed Plover (379-380)         | <i>Charadrius dubius</i> Scopoli, 1786          | +   | +    | R            |
| 77. Kentish Plover (381-382)               | <i>Charadrius alexandrinus</i> Linnaeus, 1758   | -   | +    | M            |
| 78. Lesser Sand Plover (384-384a)          | <i>Charadrius mongolus</i> Pallas, 1776         | -   | +    | M            |
| 79. Greater Sand Plover (374)              | <i>Charadrius leschenaultii</i> Lesson, 1826    | -   | +    | M            |
| 80. Caspian Plover (376)                   | <i>Charadrius asiaticus</i> Pallas, 1773        | -   | +    | M            |
| 81. Yellow-wattled Lapwing (370)           | <i>Vanellus malabaricus</i> (Boddaert, 1783)    | +   | +    | R            |
| 82. Grey-headed Lapwing (365)              | <i>Vanellus cinereus</i> (Linnaeus, 1758)       | -   | +    | M            |
| 83. Red-wattled Lapwing (366-368)          | <i>Vanellus indicus</i> (Boddaert, 1783)        | +   | +    | R            |
| 84. White-tailed Lapwing (362)             | <i>Vanellus leucurus</i> (Lichtenstein, 1823)   | -   | +    | M            |
| <b>XVIII. SCOLOPACIDAE</b>                 |                                                 |     |      |              |
| 85. Wood Snipe (405)                       | <i>Gallinago nemoricola</i> Hodgson, 1836       | -   | +    | M, VU        |
| 86. Pintail Snipe (406)                    | <i>Gallinago stenura</i> (Bonaparte, 1830)      | -   | +    | M            |
| 87. Great Snipe (408)                      | <i>Gallinago media</i> (Latham, 1787)           | -   | +    | M, NT        |
| 88. Common Snipe (409)                     | <i>Gallinago gallinago</i> (Linnaeus, 1758)     | +   | +    | M            |
| 89. Jack Snipe (410)                       | <i>Lymnocyrtus minimus</i> (Brtinnich, 1764)    | -   | +    | M            |
| 90. Black-tailed Godwit (389-390)          | <i>Limosa limosa</i> (Linnaeus, 1758)           | +   | +    | M            |
| 91. Bar-tailed Godwit (391-391a)           | <i>Limosa lapponica</i> (Linnaeus, 1758)        | +   | +    | M            |
| 92. Whimbrel (385-386)                     | <i>Numenius phaeopus</i> (Linnaeus, 1758)       | +   | +    | M            |
| 93. Eurasian Curlew (387-388)              | <i>Numenius arquata</i> (Linnaeus, 1758)        | +   | +    | M            |
| 94. Common Redshank (393, 394)             | <i>Tringa totanus</i> (Linnaeus, 1758)          | +   | +    | M            |
| 95. Marsh Sandpiper (395)                  | <i>Tringa stagnatilis</i> (Bechstein, 1803)     | +   | +    | M            |
| 96. Common Greenshank (396)                | <i>Tringa nebularia</i> (Gunner, 1767)          | +   | +    | M            |
| 97. Green Sandpiper (397)                  | <i>Tringa ochropus</i> Linnaeus, 1758           | +   | +    | M            |
| 98. Wood Sandpiper (398)                   | <i>Tringa glareola</i> Linnaeus, 1758           | +   | +    | M            |
| 99. Terek Sandpiper (400)                  | <i>Xenus cinereus</i> (Guldenstadt, 1774)       | -   | +    | M            |
| 100. Common Sandpiper (401)                | <i>Actitis hypoleucos</i> Linnaeus, 1758        | +   | +    | M            |
| 101. Sanderling (414)                      | <i>Calidris alba</i> (Pallas, 1764)             | -   | +    | M            |
| 102. Little Stint (416)                    | <i>Calidris minuta</i> (Leisler, 1812)          | -   | +    | M            |
| 103. Temminck's Stint (417)                | <i>Calidris temminckii</i> (Leisler, 1812)      | -   | +    | M            |
| 104. Dunlin (420, 421)                     | <i>Calidris alpina</i> (Linnaeus, 1758)         | -   | +    | M            |

| Family / Common Name                                | Scientific name                                       | Vem | Kole | Status banad |
|-----------------------------------------------------|-------------------------------------------------------|-----|------|--------------|
| 105. Curlew Sandpiper (422)                         | <i>Calidris ferruginea</i><br>(Pontoppidan, 1813)     | -   | +    | M            |
| 106. Broad-billed Sandpiper (424-425)               | <i>Limicola falcinellus</i><br>(Pontoppidan, 1763)    | -   | +    | M            |
| <b>XIX. RECURVIROSTRIDAE</b>                        |                                                       |     |      |              |
| 107. Black-winged Stilt (430-431)                   | <i>Himantopus himantopus</i><br>(Linnaeus, 1758)      | +   | +    | M            |
| <b>XX. BURHINIDAE</b>                               |                                                       |     |      |              |
| 108. Stone-Curlew (435-436)                         | <i>Burhinus oedicephalus</i><br>(Linnaeus, 1758)      | -   | +    | R            |
| <b>XXI. GLAREOLIDAE</b>                             |                                                       |     |      |              |
| 109. Oriental Pratincole (443)                      | <i>Glareola maldivarum</i> J.R. Forster, 1795         | -   | +    | M            |
| 110. Small Pratincole (444)                         | <i>Glareola lactea</i> Temminck, 1820                 | +   | +    | R            |
| <b>XXII. LARIDAE</b>                                |                                                       |     |      |              |
| 111. Pallas's Gull (453)                            | <i>Larus ichthyaetus</i> Pallas, 1773                 | -   | +    | M            |
| 112. Brown-headed Gull (454)                        | <i>Larus brunnicephalus</i> Jerdon, 1840              | +   | +    | M            |
| 113. Black-headed Gull (455)                        | <i>Larus ridibundus</i> Linnaeus, 1766                | +   | +    | M            |
| 114. Gull-billed Tern (460-461)                     | <i>Gelochelidon nilotica</i> (Gmelin, 1789)           | +   | +    | M            |
| 115. Caspian Tern (462)                             | <i>Sterna caspia</i> Pallas, 1770                     | +   | +    | M            |
| 116. River Tern (463)                               | <i>Sterna aurantia</i> J.E. Gray, 1831                | -   | +    | R            |
| 117. Lesser Crested Tern (479)                      | <i>Sterna bengalensis</i> Lesson, 1831                | +   | +    | M            |
| 118. Large Crested Tern (478)                       | <i>Sterna bergii</i> Lichtenstein, 1823               | +   | +    | M            |
| 119. Sandwich Tern (480)                            | <i>Sterna sandvicensis</i> Latham, 1787               | -   | +    | M            |
| 120. Black-naped Tern (468-469)                     | <i>Sterna sumatrana</i> Raffles, 1822                 | -   | +    | M            |
| 121. Common Tern (464-465)                          | <i>Sterna hirundo</i> Linnaeus, 1758                  | -   | +    | M            |
| 122. Little Tern (475-476)                          | <i>Sterna albifrons</i> Pallas, 1764                  | -   | +    | M            |
| 123. Black-bellied Tern (470)                       | <i>Sterna acuticauda</i> J.E. Gray, 1831              | -   | +    | R. NT        |
| 124. Whiskered Tern (458)                           | <i>Chlidonias hybridus</i> (Pallas, 1811)             | +   | +    | M            |
| 125. White-winged Black Tern (459)                  | <i>Chlidonias leucopterus</i><br>(Temminck, 1815)     | -   | +    | M            |
| 126. Saunders's Tern (477)                          | <i>Sterna saundersi</i> Hume, 1877                    | +   | -    | M            |
| 127. Sooty Tern (474)                               | <i>Sterna fuscata</i> Linnaeus, 1766                  | +   | -    | M            |
| <b>XXIII. COLUMBIDAE</b>                            |                                                       |     |      |              |
| 128. Blue Rock Pigeon (516-517)                     | <i>Columba livia</i> Gmelin, 1789                     | +   | +    | R            |
| 129. Spotted Dove (537-540)                         | <i>Streptopelia chinensis</i> (Scopoli, 1786)         | +   | +    | R            |
| 130. Pompadour Green-Pigeon (496-500)               | <i>Treron pompadora</i> (Gmelin, 1789)                | -   | +    | R            |
| 131. Emerald Dove (542-544a)                        | <i>Chalcophaps indica</i> (Linnaeus, 1758)            | +   | -    | R            |
| <b>XXIV. PSITTACIDAE</b>                            |                                                       |     |      |              |
| 132. Indian (Vernal) Hanging-Parrot (566, 567)      | <i>Loriculus vernalis</i> (Sparman, 1787)             | +   | -    | R            |
| 133. Rose-ringed Parakeet (549-550)                 | <i>Psittacula krameri</i> (Scopoli, 1769)             | +   | +    | R            |
| 134. Plum-headed Parakeet (557-558)                 | <i>Psittacula cyanocephala</i><br>(Linnaeus, 1766)    | +   | +    | R            |
| <b>XXV. CUCULIDAE</b>                               |                                                       |     |      |              |
| 135. Pied Crested Cuckoo (570-571)                  | <i>Clamator jacobinus</i> (Boddaert, 1783)            | +   | -    | R            |
| 136. Brainfever Bird / Common Hawk-Cuckoo (573-574) | <i>Hierococcyx varius</i> (Vahl, 1797)                | +   | -    | R            |
| 137. Indian Cuckoo (576)                            | <i>Cuculus micropterus</i> Gould, 1838                | +   | +    | R            |
| 138. Banded Bay Cuckoo (582-583)                    | <i>Cacomantis sonneratii</i> (Latham, 1790)           | -   | +    | R            |
| 139. Indian Plaintive (Grey-bellied) Cuckoo (584)   | <i>Cacomantis passerinus</i> (Vahl, 1797)             | -   | +    | R            |
| 140. Asian Koel (590-592)                           | <i>Eudynamis scolopacea</i><br>(Linnaeus, 1758)       | +   | +    | R            |
| 141. Small Green-billed (Blue-faced) Malkoha (595)  | <i>Phaenicophaeus viridirostris</i><br>(Jerdon, 1840) | -   | +    | R            |
| 142. Greater Coucal (600-602)                       | <i>Centropus sinensis</i> (Stephens, 1815)            | +   | +    | R            |

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|-------------------------------------------------------------------------|-----------------------------------------------------|-----|------|--------------|
| <b>XXVI. TYTONIDAE</b>                                                  |                                                     |     |      |              |
| 143. Barn Owl (606-607)                                                 | <i>Tyto alba</i> (Scopoli, 1769)                    | +   | +    | R            |
| <b>XXVII. STRIGIDAE</b>                                                 |                                                     |     |      |              |
| 144. Collared Scops-Owl (619-624)                                       | <i>Otus bakkamoena</i> Pennant, 1769                | +   | +    | R            |
| 145. Brown Fish-Owl (631-632)                                           | <i>Ketupa zeylonensis</i> (Gmelin, 1788)            | +   | +    | R            |
| 146. Mottled Wood-Owl (655-657)                                         | <i>Strix ocellata</i> (Lesson, 1839)                | +   | +    | R            |
| 147. Spotted Owlet (650-652)                                            | <i>Athene brama</i> (Temminck, 1821)                | +   | +    | R            |
| 148. Jungle Owlet (636-637)                                             | <i>Glaucidium radiatum</i> (Tickell, 1833)          | +   | -    | R            |
| 149. Brown Hawk-Owl (642-645)                                           | <i>Ninox scutulata</i> (Rames, 1822)                | +   | +    | R            |
| <b>XXVIII. CAPRIMULGIDAE</b>                                            |                                                     |     |      |              |
| 150. Common Indian Nightjar (680-681)                                   | <i>Caprimulgus asiaticus</i> Latham, 1790           | -   | +    | R            |
| 151. Franklin's (Savanna) Nightjar (682)                                | <i>Caprimulgus affinis</i> Horsfield, 1821          | -   | +    | R            |
| <b>XXIX. APODIDAE</b>                                                   |                                                     |     |      |              |
| 152. Indian Edible-nest Swiftlet (685)                                  | <i>Collocalia unicolor</i> (Jerdon, 1840)           | +   | +    | R            |
| 153. Brown-backed Needletail-Swift (691)                                | <i>Hirundapus giganteus</i> (Temminck, 1846)        | -   | +    | R            |
| 154. Alpine Swift (693-695)                                             | <i>Apus apus</i> (Linnaeus, 1758)                   | +   | -    | R            |
| 155. Asian Palm-Swift (707-708)                                         | <i>Cypsiurus balasienensis</i> (J.E. Gray, 1829)    | +   | +    | R            |
| 156. House Swift (702-706)                                              | <i>Apus affinis</i> (J.E. Gray, 1830)               | +   | +    | R            |
| <b>XXX. HEMIPROCINIDAE</b>                                              |                                                     |     |      |              |
| 157. Crested Tree-Swift (709)                                           | <i>Hemiprocne coronata</i> (Tickell, 1833)          | +   | +    | R            |
| <b>XXXI. ALCEDINIDAE</b>                                                |                                                     |     |      |              |
| 158. Small Blue Kingfisher (722-724)                                    | <i>Alcedo atthis</i> (Linnaeus, 1758)               | +   | +    | R            |
| 159. Stork-billed Kingfisher (730-732)                                  | <i>Halcyon capensis</i> (Linnaeus, 1766)            | +   | +    | R            |
| 160. White-breasted Kingfisher (735- 738)                               | <i>Halcyon smyrnensis</i> (Linnaeus, 1758)          | +   | +    | R            |
| 161. Black-capped Kingfisher (739)                                      | <i>Halcyon pileata</i> (Boddaert, 1783)             | +   | +    | M            |
| 162. Lesser Pied Kingfisher (719-720)                                   | <i>Ceryle rudis</i> (Linnaeus, 1758)                | +   | +    | R            |
| <b>XXXII. MEROPIIDAE</b>                                                |                                                     |     |      |              |
| 163. Small Bee-eater (749-752)                                          | <i>Merops orientalis</i> Latham, 1801               | +   | +    | R            |
| 164. Chestnut-headed Bee-eater (744-745)                                | <i>Merops leschenaulti</i> Vieillot, 1817           | +   | -    | R            |
| 165. Blue-tailed Bee-eater (748)                                        | <i>Merops philippinus</i> Linnaeus, 1766            | +   | +    | M            |
| <b>XXXIII. CORACIIDAE</b>                                               |                                                     |     |      |              |
| 166. Indian Roller (755-757)                                            | <i>Coracias benghalensis</i> (Linnaeus, 1758)       | +   | +    | R            |
| <b>XXXIV. UPUPIIDAE</b>                                                 |                                                     |     |      |              |
| 167. Common Hoopoe (763-766)                                            | <i>Upupa epops</i> Linnaeus, 1758                   | +   | +    | R            |
| <b>XXXV. CAPITONIDAE</b>                                                |                                                     |     |      |              |
| 168. White-cheeked Barbet (785)                                         | <i>Megalaima viridis</i> (Boddaert, 1783)           | +   | +    | R            |
| 169. Coppersmith Barbet (792)                                           | <i>Megalaima haemacephala</i> (PoLoSo Muller, 1771) | +   | +    | R            |
| <b>XXXVI. PICIDAE</b>                                                   |                                                     |     |      |              |
| 170. Brown-capped Pygmy Woodpecker (851-854)                            | <i>Dendrocopos nanus</i> (Vigors, 1832)             | +   | +    | R            |
| 171. Yellow-fronted (Yellow-crowned) Pied Woodpecker (847)              | <i>Dendrocopos mahrattensis</i> (Latham, 1801)      | -   | +    | R            |
| 172. Little Scaly-bellied Green (Streak-throated) Woodpecker (808)      | <i>Picus xanthopygaeus</i> (JoEo Gray & GoRo Gray)  | -   | +    | R            |
| 173. Lesser Golden-backed Woodpecker / Black-rumped Flameback (818-823) | <i>Dinopium benghalense</i> (Linnaeus, 1758)        | +   | +    | R            |
| 174. Greater Golden-backed Woodpecker / Greater Flameback (860-863)     | <i>Chrysocolaptes lucidus</i> (Scopoli, 1786)       | +   | +    | R            |
| <b>XXXVII. PITTIDAE</b>                                                 |                                                     |     |      |              |
| 175. Indian Pitta (867)                                                 | <i>Pitta brachyura</i> (Linnaeus, 1766)             | +   | +    | M            |
| <b>XXXVIII. ALAUDIDAE</b>                                               |                                                     |     |      |              |
| 176. Ashy-crowned Sparrow-Lark (878)                                    | <i>Eremopterix grisea</i> (Scopoli, 1786)           | +   | +    | R            |
| 177. Malabar Crested Lark (901)                                         | <i>Galerida malabarica</i> (Scopoli, 1786)          | +   | +    | R            |
| 178. Eastern Skylark (904-909)                                          | <i>Alauda gulgula</i> Franklin, 1831                | +   | -    | R            |

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|----------------------------------------------------------------|--------------------------------------------------|-----|------|--------------|
| <b>XXXIX. HIRUNDINIDAE</b>                                     |                                                  |     |      |              |
| 179. Plain Martin (912)                                        | <i>Riparia paludicola</i> (Vieillot, 1817)       | -   | +    | M            |
| 180. Common (Barn) Swallow (916-918)                           | <i>Hirundo rustica</i> Linnaeus, 1758            | +   | +    | M            |
| 181. Wire-tailed Swallow (921)                                 | <i>Hirundo smithii</i> Leach, 1818               | +   | +    | M            |
| 182. Red-rumped Swallow (923-928)                              | <i>Hirundo daurica</i> Linnaeus, 1771            | +   | +    | R            |
| <b>XL. MOTACILLIDAE</b>                                        |                                                  |     |      |              |
| 183. White Wagtail (1885-1890)                                 | <i>Motacilla alba</i> Linnaeus, 1758             | +   | +    | M            |
| 184. Large Pied (White-browed) Wagtail (1891)                  | <i>Motacilla maderaspatensis</i> Gmelin, 1789    | +   | +    | R            |
| 185. Yellow Wagtail (1875-1880)                                | <i>Motacilla flava</i> Linnaeus, 1758            | +   | +    | M            |
| 186. Grey Wagtail (1884)                                       | <i>Motacilla cinerea</i> Tunstall, 1771          | +   | +    | M            |
| 187. Paddyfield Pipit (1858-1860)                              | <i>Anthus rufulus</i> Vieillot, 1818             | +   | +    | R            |
| <b>XLI. CAMPEPHAGIDAE</b>                                      |                                                  |     |      |              |
| 188. Large Cuckoo-Shrike (1072-1075)                           | <i>Coracina macei</i> (Lesson, 1830)             | +   | +    | R            |
| 189. Black-headed Cuckoo-Shrike (1078-1079)                    | <i>Coracina melanoptera</i> (Rippell, 1839)      | +   | +    | R            |
| 190. Small Minivet (1090-1095)                                 | <i>Pericrocotus cinnamomeus</i> (Linnaeus, 1766) | +   | +    | R            |
| 191. Scarlet Minivet (1080-1083)                               | <i>Pericrocotus flammeus</i> (Forster, 1781)     | +   | -    | R            |
| 192. Common Woodshrike (1069-1071)                             | <i>Tephrodornis pondicerianus</i> (Gmelin, 1789) | +   | +    | R            |
| <b>XLII. PYCNONOTIDAE</b>                                      |                                                  |     |      |              |
| 193. Red-whiskered Bulbul (1118-1122)                          | <i>Pycnonotus jocosus</i> (Linnaeus, 1758)       | +   | +    | R            |
| 194. Red-vented Bulbul (1126-1132)                             | <i>Pycnonotus cafer</i> (Linnaeus, 1766)         | +   | +    | R            |
| 195. White-browed Bulbul (1138-1139)                           | <i>Pycnonotus luteolus</i> (Lesson, 1841)        | +   | +    | R            |
| <b>XLIII. IRENIDAE</b>                                         |                                                  |     |      |              |
| 196. Common Iora (1097-1101)                                   | <i>Aegithina tiphia</i> (Linnaeus, 1758)         | +   | +    | R            |
| 197. Jerdon's Chloropsis (1107-1108)                           | <i>Chloropsis cochinchinensis</i> (Gmelin, 1788) | +   | +    | R            |
| 198. Gold-fronted Chloropsis (1103-1105)                       | <i>Chloropsis aurifrons</i> (Temminck, 1829)     | +   | +    | R            |
| <b>XLIV. LANIIDAE</b>                                          |                                                  |     |      |              |
| 199. Brown Shrike (949-950a)                                   | <i>Lanius cristatus</i> Linnaeus, 1758           | +   | +    | M            |
| 200. Rufous-backed (Long-tailed) Shrike (946-948)              | <i>Lanius schach</i> Linnaeus, 1758              | -   | +    | R            |
| <b>XLV. TURDINAE</b>                                           |                                                  |     |      |              |
| 201. Orange-headed Thrush (1733-1736)                          | <i>Zoothera citrine</i> (Latham, 1790)           | +   | -    | R            |
| 202. Oriental Magpie-Robin (1661-1664)                         | <i>Copsychus saularis</i> (Linnaeus, 1758)       | +   | +    | R            |
| 203. Indian Robin (1717-1721)                                  | <i>Saxicoloides fulicata</i> (Linnaeus, 1776)    | +   | +    | R            |
| 204. Black Redstart (1671-1672)                                | <i>Phoenicurus ochruros</i> (Gmelin, 1774)       | -   | +    | M            |
| 205. Pied Bushchat (1700-1703)                                 | <i>Saxicola caprata</i> (Linnaeus, 1766)         | +   | +    | R            |
| 206. Bluethroat (1644-1646)                                    | <i>Luscinia svecica</i> (Linnaeus, 1758)         | +   | -    | M            |
| 207. Desert Wheatear (1709-1710)                               | <i>Oenanthe deserti</i> (Temminck, 1825)         | -   | +    | M            |
| <b>XLVI. TIMALIINAE</b>                                        |                                                  |     |      |              |
| 208. Spotted (Puff-throated) Babbler (1152-1159)               | <i>Pellorneum ruficeps</i> Swamson, 1832         | -   | +    | R            |
| 209. Jungle Babbler (1261-1265)                                | <i>Turdoides striatus</i> (Dumont, 1823)         | +   | +    | R            |
| 210. White-headed (Yellow-billed) Babbler (1267-1268)          | <i>Turdoides affinis</i> (Jerdon, 1847)          | +   | +    | R            |
| <b>XLVII. SYLVIINAE</b>                                        |                                                  |     |      |              |
| 211. Streaked Fantail-Warbler (Zitting Cisticola) (1498-1500a) | <i>Cisticola juncidis</i> (Rafmesque, 1810)      | +   | +    | M            |
| 212. Franklin's (Grey-breasted) Prinia (1502-1505)             | <i>Prinia hodgsonii</i> Blyth, 1844              | +   | +    | R            |
| 213. Ashy Prinia (1515-1518)                                   | <i>Prinia socialis</i> Sykes, 1832               | +   | +    | R            |



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| 214. Plain Prinia (1510-1514)                                           | <i>Prinia inornata</i> Sykes, 1832                            | +   | +    | R            |
| 215. Paddyfield Warbler (1557-1558)                                     | <i>Acrocephalus agricola</i> (Jerdon, 1845)                   | -   | +    | M            |
| 216. Blyth's Reed-Warbler (1556)                                        | <i>Acrocephalus dumetorum</i> Blyth, 1849                     | +   | +    | M            |
| 217. Indian Great (Clamorous) Reed-Warbler (1553)                       | <i>Acrocephalus stentoreus</i> . (Hemprich & Ehrenberg, 1833) | -   | +    | M            |
| 218. Common Tailorbird (1535-1539)                                      | <i>Orthotomus sutorius</i> (Pennant, 1769)                    | +   | +    | R            |
| 219. Greenish Leaf-Warbler (1602-1605)                                  | <i>Phylloscopus trochiloides</i> (Sundevall, 1837)            | +   | +    | M            |
| <b>XLVIII. MUSCICAPINAE</b>                                             |                                                               |     |      |              |
| 220. Asian Brown Flycatcher (1407)                                      | <i>Muscicapa dauurica</i> Pallas, 1811                        | +   | +    | M            |
| <b>XLIX. MONARCHINAE</b>                                                |                                                               |     |      |              |
| 221. Asian Paradise-Flycatcher (1460-1464)                              | <i>Terpsiphone paradisi</i> (Linnaeus, 1758)                  | +   | +    | M            |
| <b>L. RHIPIDURINAE</b>                                                  |                                                               |     |      |              |
| 222. White-browed Fantail-Flycatcher (1451-1453)                        | <i>Rhipidura aureola</i> Lesson, 1830                         | +   | +    | R            |
| <b>LI. DICAETIDAE</b>                                                   |                                                               |     |      |              |
| 223. Thick-billed Flowerpecker (1892-1894)                              | <i>Dicaeum agile</i> (Tickell, 1833)                          | +   | +    | R            |
| 224. Tickell's (Pale-billed) Flowerpecker (1899-1900)                   | <i>Dicaeum erythrorhynchos</i> (Latham, 1790)                 | +   | +    | R            |
| 225. Plain Flowerpecker (1901-1903) (Nilgiri Flowerpecker)              | <i>Dicaeum concolor</i> Jerdon, 1840                          | -   | +    | R            |
| <b>LII. NECTARINIIDAE</b>                                               |                                                               |     |      |              |
| 226. Purple-rumped Sunbird (1907-1908)                                  | <i>Nectarinia zeylonica</i> (Linnaeus, 1766)                  | +   | +    | R            |
| 227. Purple Sunbird (1916-1918)                                         | <i>Nectarinia asiatica</i> (Latham, 1790)                     | +   | +    | R            |
| 228. Loten's Sunbird (1911-1912)                                        | <i>Nectarinia lotenia</i> (Linnaeus, 1766)                    | +   | +    | R            |
| <b>LIII. FRINGILLIDAE</b>                                               |                                                               |     |      |              |
| 229. Common Rosefinch (2010-2013)                                       | <i>Carpodacus erythrinus</i> (Pallas, 1770)                   | -   | +    | M            |
| <b>LIV. ESTRILDIDAE</b>                                                 |                                                               |     |      |              |
| 230. Red Munia / Red Avadavat (1964)                                    | <i>Amandava amandava</i> (Linnaeus, 1758)                     | -   | +    | R            |
| 231. White-rumped Munia (1967-1970) (White-backed)                      | <i>Lonchura striata</i> (Linnaeus, 1766)                      | +   | +    | R            |
| 232. Spotted (Scaly-breasted) Munia (1974-1975)                         | <i>Lonchura punctulata</i> (Linnaeus, 1758)                   | +   | +    | R            |
| 233. Black-headed Munia (1976-1978)                                     | <i>Lonchura malacca</i> (Linnaeus, 1766)                      | +   | +    | R            |
| <b>LV. PASSERINAE</b>                                                   |                                                               |     |      |              |
| 234. House Sparrow (1938-1939a)                                         | <i>Passer domesticus</i> (Linnaeus, 1758)                     | +   | +    | R            |
| 235. Yellow-throated Sparrow (Chestnut-shouldered Petronia) (1948-1949) | <i>Petronia xanthocollis</i> (Burton, 1838)                   | +   | +    | R            |
| <b>LVI. PLOCEINAE</b>                                                   |                                                               |     |      |              |
| 236. Streaked Weaver (1962-1963)                                        | <i>Ploceus manyar</i> (Horsfield, 1821)                       | +   | +    | R            |
| 237. Baya Weaver (1957-1959)                                            | <i>Ploceus philippinus</i> (Linnaeus, 1766)                   | +   | +    | R            |
| <b>LVII. STURNIDAE</b>                                                  |                                                               |     |      |              |
| 238. Grey-headed (Chestnut-tailed) Starling (1987-1989)                 | <i>Sturnus malabaricus</i> (Gmelin, 1789)                     | +   | +    | M            |
| 239. Brahminy Starling (1994)                                           | <i>Sturnus pagodarum</i> (Gmelin, 1789)                       | +   | +    | R            |
| 240. Rosy Starling (1996)                                               | <i>Sturnus roseus</i> (Linnaeus, 1758)                        | +   | +    | M            |
| 241. Common Starling (1997-1001)                                        | <i>Sturnus vulgaris</i> Linnaeus, 1758                        | -   | +    | M            |
| 242. Common Myna (1006-1007)                                            | <i>Acridotheres tristis</i> (Linnaeus, 1766)                  | +   | +    | R            |
| 243. Jungle Myna (1009-1011)                                            | <i>Acridotheres fuscus</i> (Wagler, 1827)                     | +   | +    | R            |
| <b>LVIII. ORIOLIDAE</b>                                                 |                                                               |     |      |              |
| 244. Eurasian Golden Oriole (1952-1957)                                 | <i>Oriolus oriolus</i> (Linnaeus, 1758)                       | +   | +    | M            |
| 245. Black-headed (hooded) Oriole (1958-1960a)                          | <i>Oriolus xanthornus</i> (Linnaeus, 1758)                    | +   | +    | R            |

| Family / Common Name                      | Scientific name                             | Vem | Kole | Status banad |
|-------------------------------------------|---------------------------------------------|-----|------|--------------|
| <b>LIX. DICRURIDAE</b>                    |                                             |     |      |              |
| 246. Black Drongo (962-964)               | <i>Dicrurus macrocercus</i> Vieillot, 1817  | +   | +    | R            |
| 247. Ashy Drongo (965-966b)               | <i>Dicrurus leucophaeus</i> Vieillot, 1817  | +   | +    | M            |
| 248. Bronzed Drongo (971)                 | <i>Dicrurus aeneus</i> Vieillot, 1817       | +   | -    |              |
| <b>LX. ARTAMIDAE</b>                      |                                             |     |      |              |
| 249. Ashy Woodswallow (982)               | <i>Artamus fuscus</i> Vieillot, 1817        | +   | +    | R            |
| <b>LXI. CORVIDAE</b>                      |                                             |     |      |              |
| 250. Indian (Rufous) Treepie (1030a-1034) | <i>Dendrocitta vagabunda</i> (Latham, 1790) | +   | +    | R            |
| 251. House Crow (1048-1051)               | <i>Corvus splendens</i> Vieillot, 1817      | +   | +    | R            |
| 252. Jungle Crow (1054-1057)              | <i>Corvus macrorhynchos</i> Wagler, 1827    | +   | +    | R            |

#### Legend

- a. (225-256) - Numbers within brackets after the common names are the numbers given to species in Ripley's (1982) Synopsis, which was also followed in Ali & Ripley's (1987) Handbook.
- b. UV = Vulnerable (Bird Life International 2001). e. M = Migrant
- c. NT = Near Threatened (Bird Life International 2001). f. "+" = present
- d. R = Resident g. "-" = absent

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# Avifauna of Ramanakere, Cheelur, Davanagere District

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## Introduction

Freshwater wetlands are fragile ecosystems, which are fast deteriorating, and shrinking due to man-made activities. India has 65,000 wetlands covering an area of 4.5 million hectares (Anon, 1990). A good number of reports on wetlands in relation to birds have been published in India (Vijayan, 1991; Sampath and Krishnamurthy, 1993). Although considerable amount of literature is available on wetlands avifauna in India, they are mostly pertaining to some selected and well-known sites (Wolstencraft *et al.*, 1989). There is an urgent need to undertake the study of important bird areas like other small wetlands, spread across the country. In the present investigation, Ramanakere of Cheelur village was selected for the survey of waterfowls and checklist was prepared to ascertain the status of the wetland ecosystem of waterfowls in the area.

## Materials and Methods

The Cheelur is situated at a distance of about 25 km from Shimoga on the east and belongs to the newly formed Davanagere district. It received rain runoff from the surrounding catchment and also from Tunga irrigation channel. The Ramanakere is a perennial pond spread in an area of 82.12 acres and the water spread area is 38 acres. Due to encroachment and other anthropogenic disturbances the resident and local migratory birds are threatened. It is an ideal habitat for wetland birds. On northern side it is joined to Shimoga - Honnali road and on southern side agricultural croplands are seen.

The northern end is having shallow water infested by emergent plants dominated by *Ipomea aquatica*. The other flora of the pond includes floating hydrophytes viz., *Pistia*, *Lemna*, *Azolla*, *Lotus* and *Nelumbo*. A variety of emergent and submergent vegetations are also witnessed.

The pond was visited once in a week from October 2001 to September 2002. The birds were identified by available field guides, Sonobe & Usui (1993) and Salim Ali (1996) and with a pair of binoculars (5 x 50) while walking over the bund of the pond.

## Results and Discussion

In the present investigation identified 46 species belonging to 15 families. Among the 46 species observed, 8 species were resident, 14 species resident cum local migrant, 13 migrants, 2 partial, 4 occasional, and 2 were winter migratory as indicated by Ali (1996).

A few suggestions to conserve the avifauna of Cheelur pond are suggested as follows,

1. Planting of trees to attract roosting birds may be considered.
2. In this wetland fishing activity interferes with the various activities of the birds, hence it should be minimized or banned.
3. Fencing the pond to protect from encroachment and poaching activities.
4. Stopping of sewage and other pollutants entering the tank.
5. Aquatic weed control by biological and mechanical methods is needed.
6. Grazing of cattle should be avoided.
7. Create a general awareness among the local people about pond as an important bird area, which helps in the biological control of insects' pests in the surrounding croplands.

Table 1. List of Birds with their status and food habit in Avifauna of Ramanakere during the study period

| Sl. No. | Common name                         | Scientific name                 | Status | Food habit |
|---------|-------------------------------------|---------------------------------|--------|------------|
|         | <b>I. Family: Anatidae</b>          |                                 |        |            |
| 1       | Pintail                             | <i>Anus acuta</i>               | M      | O          |
| 2       | Lesser whistling Teal               | <i>Dendrocygna javanica</i>     | RLM    | O          |
| 3       | Garganey                            | <i>Anas querquedula</i>         | M      | O          |
| 4       | Nakta or Comb Duck                  | <i>Sarkidiornis melanotos</i>   | PM     | O          |
| 5       | Cotton Teal                         | <i>Nettapus coromandelianus</i> | CR     | O          |
| 6       | Spotbilled Duck                     | <i>Anas poeciloryncha</i>       | CR     | O          |
| 7       | Mallard                             | <i>Anas platyrhynchos</i>       | M      | O          |
| 8       | Shoveler                            | <i>Anas clypeata</i>            | M      | O          |
|         | <b>II. Family: Alcedinidae</b>      |                                 |        |            |
| 9       | Lesser pied Kingfisher              | <i>Ceryle rudis</i>             | LM     | P          |
| 10      | Small blue Kingfisher               | <i>Alcedo atthis</i>            | LM     | P          |
| 11      | White-breasted Kingfisher           | <i>Halcyon smyrnensis</i>       | LM     | P          |
|         | <b>III. Family: Rallidae</b>        |                                 |        |            |
| 12      | Brown Crake                         | <i>Amouromis akool</i>          | R      | I          |
| 13      | Whitebreasted Waterhen              | <i>Amauromis phoenicurus</i>    | R      | I,G        |
| 14      | Indian Moorhen                      | <i>Gallinula chloropus</i>      | R      | O          |
| 15      | Purple Moorhen                      | <i>Porphyrio porphyrio</i>      | R      | O          |
| 16      | Coot                                | <i>Fulica atra</i>              | CM     | O          |
| 17      | Water Cock or Kora                  | <i>Gallicrex cinerea</i>        | LM     | I          |
|         | <b>IV. Family: Scolopacidae</b>     |                                 |        |            |
| 18      | Marsh Sandpiper                     | <i>Tringa stagnatilis</i>       | PM     | I          |
| 19      | Black-winged Stilt                  | <i>Himantopus himantopus</i>    | M      | I          |
| 20      | Pintail Snipe                       | <i>Gallinago stenura</i>        | M      | I          |
|         | <b>V. Family: Jacanidae</b>         |                                 |        |            |
| 21      | Bronze-winged Jacana                | <i>Metopidicus indicus</i>      | R      | I,G        |
| 22      | Pheasant tailed Jacana              | <i>Hydrophasianus chirurgus</i> | R      | I,G        |
|         | <b>VI. Family: Charadriidae</b>     |                                 |        |            |
| 23      | Red-wattled Lapwing                 | <i>Vanellus indicus</i>         | R      | I          |
| 24      | Yellow-wattled Lapwing              | <i>Vanellus malabaricus</i>     | R      | I          |
| 25      | Little ringed Plover                | <i>Charadrius dubius</i>        | M      | I          |
|         | <b>VII. Family: Laridae</b>         |                                 |        |            |
| 26      | River Tern                          | <i>Sterna aurantia</i>          | M      | P          |
|         | <b>VIII. Family: Podicipedidae</b>  |                                 |        |            |
| 27      | Little Grebe                        | <i>Tachybaptus ruficollis</i>   | RLM    | P          |
|         | <b>IX. Family: Anhingidae</b>       |                                 |        |            |
| 28      | Darter or Snake bird                | <i>Anhinga melanogaster</i>     | M      | P          |
|         | <b>X. Family: Phalacrocoracidae</b> |                                 |        |            |
| 29      | Little Cormorant                    | <i>Phalacrocorax niger</i>      | RLM    | P          |

| Sl. No.                               | Common name         | Scientific name                     | Status | Food habit |
|---------------------------------------|---------------------|-------------------------------------|--------|------------|
| <b>XI. Family: Ardeidae</b>           |                     |                                     |        |            |
| 30                                    | Little Egret        | <i>Egretta garzetta</i>             | RLM    | P          |
| 31                                    | Median Egret        | <i>Egretta intermedia</i>           | RLM    | P          |
| 32                                    | Large Egret         | <i>Egretta alba</i>                 | RLM    | P          |
| 33                                    | Cattle Egret        | <i>Bubulcus ibis</i>                | RLM    | P          |
| 34                                    | Purple Heron        | <i>Ardea purpurea</i>               | OM     | P          |
| 35                                    | Grey Heron          | <i>Ardea cinerea</i>                | OM     | P          |
| 36                                    | Pond Heron          | <i>Ardeola grayii</i>               | RLM    | P          |
| <b>XII. Family: Threskiornithidae</b> |                     |                                     |        |            |
| 37                                    | Glossy Ibis         | <i>Plegadis falcinellus</i>         | OM     | P          |
| 38                                    | Black Ibis          | <i>Pseudibis papillosa</i>          | OM     | P          |
| 39                                    | Black-headed Ibis   | <i>Threaskiornis melanocephalus</i> | LM     | P          |
| <b>XIII. Family: Ciconiidae</b>       |                     |                                     |        |            |
| 40                                    | Open-bill Stork     | <i>Anastomus oscitans</i>           | WM     | P          |
| 41                                    | White-necked Stork  | <i>Ciconia episcopus</i>            | WM     | P          |
| <b>XIV. Family: Motacillidae</b>      |                     |                                     |        |            |
| 42                                    | Lesser-pied Wagtail | <i>Ceryle rudis</i>                 | M      | I          |
| 43                                    | Yellow Wagtail      | <i>Motacilla flava</i>              | M      | I          |
| 44                                    | Grey Wagtail        | <i>Motacilla cinerea</i>            | M      | I          |
| 45                                    | White Wagtail       | <i>Motacilla alba</i>               | M      | I          |
| <b>XV. Family: Alaudidae</b>          |                     |                                     |        |            |
| 46                                    | Crested Lark        | <i>Galerida cristata</i>            | RLM    | I          |

\* Common names after Manakadan *et al.*, 1998.

\* Scientific names after Inskipp *et al.*, 1996.

\* Status of the birds observed as Resident (R), Migratory (M), Local (L), Common (C), Occasional (O), Partial(P), Winter(W).

\* Observed food habit

I – Insectivore; P- Piscivore; C-Carnivore; N –Nectarivore; F- Frugivore;

O-Omnivore; G- Granivore.

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# An Account of Heronries and Other Breeding Waterbirds of Sriharikota, Andhra Pradesh, India

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## Introduction

The only known breeding sites for colonial waterbirds of Pulicat Lake are the Nelapattu, Tada and Vedurupattu-Edhirpattu heronries (Subramanya 1996a, 1996b). During a 3-year study (2001-2004) on the faunal diversity of Sriharikota Island, including its avifauna (Manakadan & Sivakumar, 2004), we located three nesting sites of colonial waterbirds in the Island. The discovery of these heronries further adds to the total of earlier 41 known breeding sites of colonial waterbirds in Andhra Pradesh (Subramanya, 1996b). In this paper, we provide accounts of the three heronries, and cite breeding records of the other waterbirds of the Island.

## Material and Methods

Sriharikota is a spindle shaped island (ca. 181 km<sup>2</sup>) situated largely in Nellore district of Andhra Pradesh, bounded on the east by the Bay of Bengal and on the west by Pulicat Lake (13°24' to 13°55' N and 80°03' to 80°18' E) (Fig. 1). The northern, southern and western edges of the Island are bordered by the waters of Pulicat Lake (ca. 460 km<sup>2</sup>); the eastern by the Bay of Bengal. The east-west dimensions of the Island vary from about nine kilometers in the central part to one kilometer in the southern parts. The Island got connected to the mainland by a road at Sullurpet (18 km) in 1970; prior to this, access was mainly by boat from Tada. The Island is a restricted area, being the spaceport of the Indian Space Research Organisation (ISRO) and ISRO has a Conservation and Landscape Division for the conservation and management of the forests and wildlife.

Sriharikota has one of the largest, best protected and last remaining tracts of Tropical Dry Evergreen Forest in India. Apart from the natural vegetation, plantations of *Eucalyptus* (*Eucalyptus* spp.), *Casuarina* (*Casuarina equisetifolia*) and Cashew (*Anacardium occidentale*) have been raised over the years. The wetlands of Sriharikota comprise lakes (both freshwater and brackish), streams (both freshwater and brackish), creeks, and natural and man-made freshwater ponds. Though the Island is affected by both the monsoons, the principal rainfall is mainly

from the North East Monsoon. The annual rainfall averages around 1200 mm. Much of the flora and the fauna of the Island have been well-documented due to the initiatives of ISRO.

## The Heronries

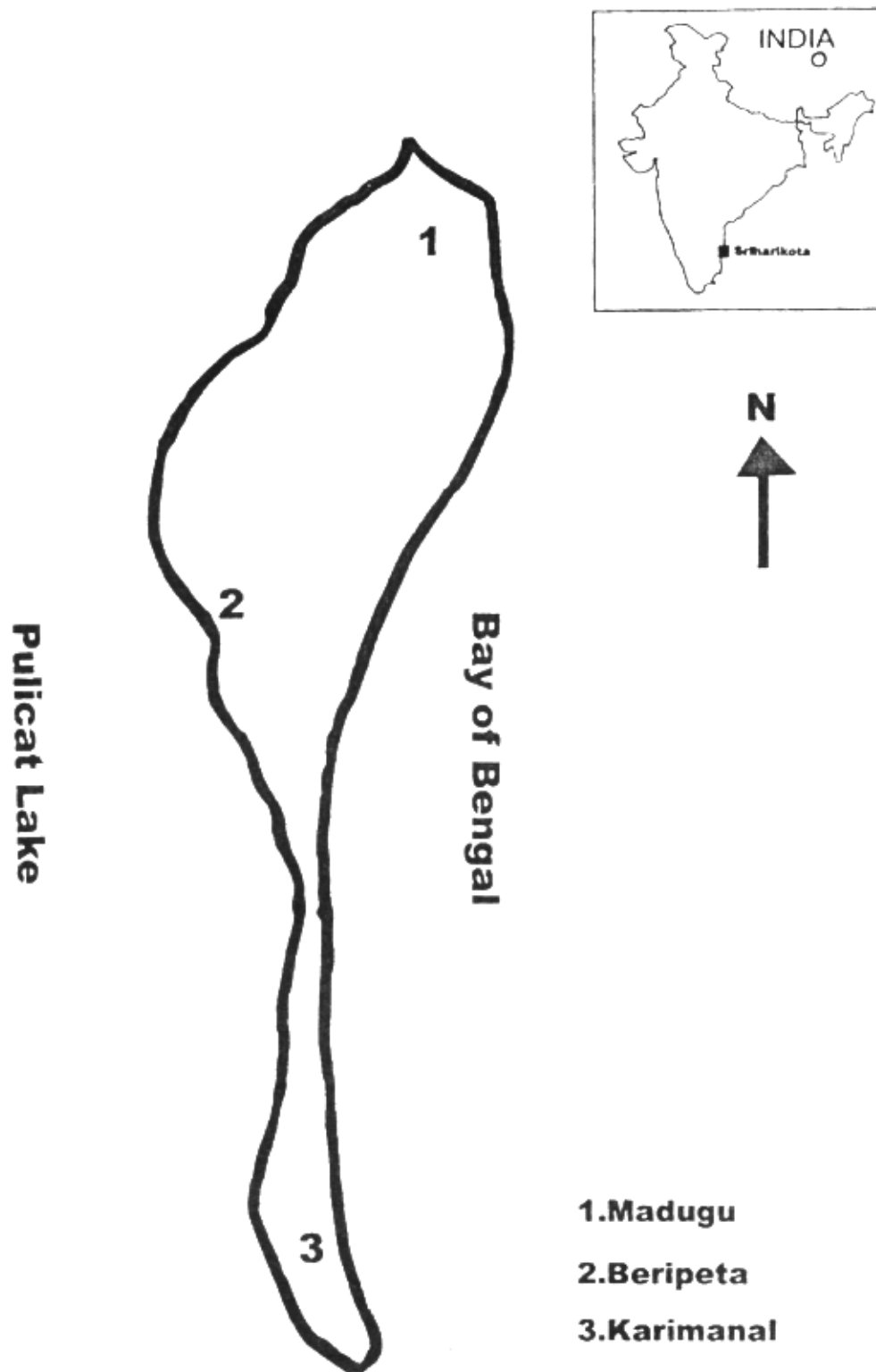
The three heronries, situated in the northern, central and southern part of the Island and named the Madugu, Beripeta and Karimanal heronries, respectively, by us after their place names, were discovered during a reconnaissance of the Island during the winter of 2001. As none of the earlier ornithologists of the Bombay Natural History Society (BNHS, 1977; Samant & Rao 1996; Rao 1998) had recorded heronries in the Island, these are in all likelihood new colonies that got established over the years due to the overall good protection afforded to wildlife by ISRO. Some locals queried said that the birds started breeding in the Beripeta and Karimanal colonies during the late 1990s. In the case of the Madugu Heronry, breeding was noticed only during 2001.

Intensive data of the heronries was not collected so as not to disturb birds and cause abandonment of nests. Additionally, approach to the nesting colonies was difficult due to the dense, thorny vegetation amidst standing water, especially in the case of the Madugu and Beripeta colonies. In fact, many parts of the Madugu Heronry were not accessible even after the drying-up of the areas due to the dense cane-breaks. Given below is an account of the heronries based primarily on data collected during the 2001-2002 season – (Table 1)

## Results and Discussion

**Beripeta Heronry:** The Beripeta Colony consisted of Painted Storks and a few Grey Herons. The nests were on large trees (12 m), including exotics such as *Peltophorum roxburghii* and *Eucalyptus* sp. This heronry has good protection due to its proximity to a security outpost, easy accessibility to the establishments of ISRO, and since it is now occasionally visited by officials of ISRO. The future prospects of this heronry appear to be excellent, and

**Fig.1 Map of Sriharikota with locations of heronries**



the ISRO should try to develop it on the lines of the heronry in Nelapattu on the mainland.

**Karimanal Heronry:** The Karimanal Colony had more diversity of species viz., Painted Stork, Grey Heron, Little Egret, Large Egret and Little Cormorant. All the nesting trees (ca.10 m), were exotic species. Though close to the Karimanal security outpost, it is out of its viewing distance as it is in a depression and subject to disturbances from fishermen of Pulicat Lake. We found an abandoned line of nooses during one of the visits. The birds of this heronry get heavily disturbed on the approach of people due to the low height of the nesting trees. Hence, even visitors should not be allowed to visit the colony, or, the birds should only be observed from a distance with binoculars. Many of the nesting trees died out by the end of the breeding season probably due to water-logging or / and inability to withstand the impact of defecation by birds. The future of this colony is

uncertain and will depend on the survival of the nesting trees, besides protection.

**Madugu Heronry:** The Madugu Colony comprised largely of the Little Egret and Grey Heron. This heronry is in a secluded area in the northern part of the Island, and prone to human disturbances. The high incidence of dead nestlings could possibly be due to abandonment of nests from disturbances or poaching of breeding pairs. We found nooses on some of the dead adults on the nests and piles of plucked feathers at some locations. *Prosopis chilensis* (2.5-3 m), the primary nesting tree, appears to be intolerant to the impact of defecation of birds as most had died out by the end of the breeding season. However, there are other species of nesting trees in the area, unlike at Karimanal (see Table 1).

During the following two years (2004-2005), birds did not breed in the Karimanal Heronry and very few birds nested in the Madugu Colony. The rainfall was low

**Table 1 Details of the heronries in Sriharikota during 2001-2003**

| Breeding Colony | Location & Habitat                                                                                                              | Nesting Tree Species& Nos.                                                                                                                                                                                                                                                                                                                                    | Breeding Species& Nos.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Beripeta        | Riparian forest with tall trees (main colony). A casuarina clump amidst thickets and cane (sub-colony, ca. 500 m to its south). | <i>Borassus flabellifer</i> = 4<br><i>Peltophorum roxburghii</i> = 4<br><i>Eucalyptus</i> = 1<br><i>Eucalyptus</i> (with cane) = 3<br><i>Ficus religiosa</i> = 2<br><i>Ficus sp.</i> = 1<br><i>Tamarindus indicus</i> = 1<br><i>Albizia amara</i> = 3<br><i>Albizia</i> (with cane) = 1<br><i>Guazuma ulmifolia</i> = 1<br><i>Casuarina equisetifolia</i> = 6 | (2001-02)<br>Painted Stork <i>Mycteria leucocephala</i> = ca. 165 nests and Grey Heron <i>Ardea cinerea</i> = 2 nests in the main colony.<br>Grey Heron = 3 nests in the sub-colony.<br>(2002-03)<br>Painted Stork = ca. 80 nests (main colony) and ca. 40 nests new site 500 m to its south.                                                                                                                                                            |
| Karimanal       | Inundated lowland with casuarinas trees.                                                                                        | <i>Casuarina equisetifolia</i> = 130<br><i>Prosopis chilensis</i> = 2 trees                                                                                                                                                                                                                                                                                   | (2001-02)<br>Little Cormorant <i>Phalacrocorax pygmeus</i> = ca. 300 nests, Painted Stork = ca. 100 nests, Grey Heron = 6 nests, Little Egret <i>Egretta garzetta</i> = ca. 100 nests, Large Egret <i>Casmerodius albus</i> = 6, Median Egret <i>Mesophoyx intermedia</i> = 1                                                                                                                                                                            |
| Madugu          | Source of the Madugu stream. Riparian with forest-thicket vegetation and dense cane breaks.                                     | <i>Prosopis chilensis</i> = 125<br><i>Casuarina equisetifolia</i> = 5<br><i>Borassus flabellifer</i> = 1<br><i>Pandanus tectorius</i> = 2<br><i>Lannea coromandelica</i> (with cane) = 2                                                                                                                                                                      | (2001-02)<br>Little Cormorant = ca. 20, Little Egret = ca. 100, Grey Heron = 13, Cattle Egret <i>Bubulcus ibis</i> = 2, Black-crowned Night-Heron <i>Nycticorax nycticorax</i> = ca. 50. (Breeding was confirmed only for Little Egret and Grey Heron - seen on nests. The other birds were only seen in the heronry area. Accessibility and counts were extremely difficult due to impenetrable cane breaks and lack of vantage spots for observations) |

during both the years and the water under the heronries dried up very quickly. However, breeding did take place in Beripeta during the subsequent years, probably since drying of water under the heronries has little impact as the nesting trees are tall, unlike in the Karimanal and Madugu heronries. However, disturbances could also have been a factor for failure or low intensity of nesting at the Karimanal and Madugu sites as discussed earlier.

### **Other Breeding Waterbirds**

Besides the three heronries, we recorded breeding by a few waterbird species, some of which were not reported by earlier workers:

**Lesser Whistling-Duck** *Dendrocygna javanica*: The Lesser Whistling-Duck was only recorded during the BNHS project in the 1970s (BNHS 1977) and not during the second project (Rao 1998). There were no reports of it breeding in the Island. During this project, we recorded two pairs, one with 14 ducklings and the other with a chick in the Chinna Wagu in April 2002.

**Spot-billed Duck** *Anas poecilorhyncha*: The Spot-billed Duck breeds throughout the Island during the N.E. Monsoon period when low-lying areas get inundated. After breeding, the birds congregate during summer and flocks of around 200 birds were frequently sighted in Urugayya Lake. Earlier workers (BNHS 1977, Rao 1998) had also recorded its breeding in the Island.

**Common Moorhen** *Gallinula chloropus*: Rao (1998) classed the Common Moorhen as *Resident* but did not mention of breeding records. We recorded adults with chicks occasionally in the Pedda and Chinna wagus during winter. Nests were also located in the Madugu Wagu.

**White-breasted Waterhen** *Amaurornis phoenicurus*: A White-breasted Waterhen with two chicks was recorded in Chinna Wagu during September 2002. Rao (1998) did not mention breeding of the species in the island.

**Kentish Plover** *Charadrius alexandrinus* & **Little Ringed Plover** *Charadrius dubius*: Rao (1998) lists the Kentish Plover as a *Winter Migrant* and the Little Ringed Plover, as *Resident*. Though we did not obtain definite breeding records, we suspect that the Kentish Plover does breed in the Island. During summer, we observed pair formations and once agitated behaviour at our approach probably as we were in the vicinity of nests or young. Incidentally, breeding records of this predominantly winter migrant

have also been obtained by the BNHS from the Great Vedaranyam Swamp, Tamil Nadu (Sugathan 1982). Regarding the Little Ringed Plover, Yanadi tribals report that the species nests in the dry bed of Katankayya Lake during summer.

**White-bellied Sea-Eagle** *Haliaeetus leucogaster*: Probably about half a dozen pairs breeds in the Island. Rao (1998) located 3 nests, one on a casuarina tree and two on high voltage transmission pylons. We located a huge nest on a *Ficus bengalensis* about 3km south of Jonangipalem during March 2002. Two fledglings were seen close to the nest during March 2003. It seems that the birds have been using the same nest repeatedly from years back.

### **Acknowledgements**

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# Water Bird Diversity at the Tanks of North Bangalore

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## **Introduction**

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. Though in the past these areas were considered unproductive and unhealthy "wastelands", over the past two decades there has been a growing awareness of their value. Wetlands are not only a source of food and fuel to the numerous communities dependent on them for subsistence but are also of immense importance. Urban wetlands through the ages have been the lifeline of most cities in India. They were preserved and looked after by the people as their main source of water supply for drinking and irrigation. These wetlands are found all over the country and are either natural or built by people. Over the years, they have gradually depleted, leading to a number of problems in urban areas such as flooding, water scarcity and water logging.

Karnataka State had about 44,000 man-made wetlands constructed over centuries beginning with the Vijayanagara Dynasty, of which there are only 36,969 wetlands. Once critical resources for supporting paddy and other irrigated crops, especially in the Maidan areas, these wetlands had bad times with the coming in of large-scale irrigation projects over the last century. Most of these tanks were haven for resident as well as migratory water birds and other dependent birds. Bangalore alone had 400 tanks but their rapid degradation over the last three decades has left only 130 tanks, of which only 80 are in good condition. In spite of these, there are quite good number of winged visitors arriving to most of these tanks during winter.

## **Materials and Methods**

The water bird census was being conducted at the respective tanks between 7 am and 10 am. The numbers of these birds were counted using binocular and spotting scope.

## **Survey programme**

Every year annual water bird count is conducted between 5<sup>th</sup> and 26<sup>th</sup> of January (as most of the migratory birds would have already arrived during this period) to understand the bird migration, number of birds arriving, change in the arrival of bird species and the tank condition. This would give a broad picture on the current condition of the tanks and the dependent birds. The annual water bird count was being conducted by our group in the tanks of North of Bangalore since five years. About 11 tanks that are situated in the North of Bangalore were considered for the water bird census. Ardeshanahalli, Doddatumkur, Hebbal, Hesaraghatta, Jakkur, Kolthur, Madhurekere, Nagavara, Puttenahalli, Singnayakanahalli and Yelahanka were the tanks spread over the north of Bangalore with varied uniqueness in terms of bird diversity and problems.

These tanks were surveyed documenting the tank condition, other activities in the tank region, the water birds and the water dependent birds along with their numbers.

## **Results and discussion**

From the year 2001 the water birds were in good number in all the tanks as they were with sufficient water and good fish population too. About 42 species of water birds and water dependent bird species were documented during the census. In Hesaraghatta tank alone, about more than 2000 water birds of 29 species were documented. It was painful to notice about 10 bird traps at the Hesaraghatta tank bed for trapping White necked and Painted Storks. The nearby villagers explained that atleast 10 to 15 storks were poached every week during their arrival and the meat were sold in local market. Later, we destroyed these traps and informed the Forest officials to take stringent action against the poachers. Hebbal and Puttenahalli tanks also harbored about 40 species of water birds totaling to more than 400 individuals respectively. Totally more than 5000 birds were documented each year from all the 11 tanks of north Bangalore.

But in the year 2004, due to acute drought, seven of these eleven tanks were in a bad shape being totally dried up. These dried tanks were used for grazing cattle and temporary vehicle parking place! The winged visitors had to be dependent on the remaining 4 tanks (Puttenahalli, Nagavara, Madhurekere and Hebbal) that had little water. Puttenahalli tank housed lot of birds including Painted Storks (*Mycteria leucocephala*), Open-billed Storks (*Anastomus oscitans*) and a few Spot-billed Pelicans (*Pelecanus philippensis*) in addition to many other water birds. Despite being a drought year, this water body had water, thanks to the efforts of Lake Development Authority in taking necessary steps to conserve water at this lake. Nagavara Tank that was earlier dry owing to the desiltation programme, now had water and attracted many water birds. Previous year, Madhurekere had about 190 Painted Storks and other birds such as Spoon Bill (*Platalea leucorodia*), White Ibis (*Threskiornis melanocephalus*), Grey Heron (*Ardea cinerea*), Black Winged Stilt (*Himantopus himantopus*), Sandpiper, River Tern (*Sterna aurantia*), Pin-tailed Duck (*Anas acuta*), Spot-billed Duck (*Anas poecilorhyncha*) and others was bone dry. It was disheartening that there were no Egret or even Pond Heron. Hebbal Tank was as usual rich with Pin Tailed Duck, Spot-billed Duck, Common Pochard (*Aythya ferina*), Garganey Teal (*Anas querquedula*), Sandpiper, Black Winged Stilt, River Tern, Grey Heron, Purple Heron (*Ardea purpurea*) etc. Jakkur Tank had interestingly Grey Heron, Spot-billed Duck, Pin-tailed Duck, Common Pochard, Egret, etc. The last one, which we surveyed, was Hesaraghatta Tank, which was having good amount of water last year and housed a lot of birds was now completely dry. The locals opined that the lake was totally dry for the first time. In the year 2003, we could observe huge number of White-necked Stork (*Ciconia episcopus*), Painted Stork, Grey Heron and other water birds in good number.

The year 2005 was fair enough for the winged visitors as the tank condition were better with sufficient water, and thus getting back most of the birds to the garden city. Traditionally community based organizations were protecting the catchments, and of regular maintenance including desilting these tanks. With lower population densities and little industry, pollution was no threat, nor had many exotic weeds been introduced. Many pressures on land have led to encroachment on tank beds. The famous Dharmambudhi tank of Bangalore has been drained to make Majestic Bus Stand. Such kind of ongoing changes in and around most of the tanks of Bangalore

will definitely block the water draining pathways, which might in turn result in water inundation and flooding at such areas in future. The tanks have become sinks for sewage and industrial wastes. Exotic weeds have come to thrive in the organically enriched waters promoting drying up of the tanks. This process of degradation of wetlands has affected many elements of biodiversity as well.

### Conclusion

- + Percent of weed coverage in the lakes to be ascertained.
- + De-weeding of water hyacinth (*Eichornia crassepis*) to be carried on war-footing basis in avian rich lakes such as Hebbal, Puttenahalli, Nagavara, Madivala, etc.
- + Constant patrolling in all the lakes to minimize poaching of birds. Eg: Hesaraghatta Tank.
- + Re-trace the water draining pathways, map them and provide the lost links.
- + Clear the already encroached areas by providing the alternatives and make the water draining points free from disturbance.
- + Alternative measures to divert the inflow of effluents.
- + Regulate the tourists and ban use of plastics in and around the tank area.
- + Afforestation programme to be taken by planting native species such as Tamarind, Pongamia, Neem, Figs, Mango, etc.
- + Install pictorial depiction of prominent birds found in the vicinity of the lakes along with the bi-lingual checklists of all birds (Resident/Migratory) found in the vicinity and update them every six months.
- + Regulate boating hours and the area covered by the boats during winter.
- + Provide dustbins at many places with in the vicinity and remove the garbage periodically.
- + Encourage nature lovers and bird watchers.

### Acknowledgments

We thank the Deputy Conservator of Forests (Bangalore Urban), all the forest officials of Karnataka Forest Department, the Chief Executive Officer and the Deputy Conservator of Forests from Lake Development Authority for constant encouragement and help during our periodical monitoring of all the 11 tanks of North Bangalore.



**Checklist of bird species recorded during the survey:**

|                           |                                    |                               |                                  |
|---------------------------|------------------------------------|-------------------------------|----------------------------------|
| 1. Little Grebe           | <i>Tachybaptus ruficollis</i>      | 22. White-breasted Waterhen   | <i>Amauornis phoenicurus</i>     |
| 2. Great Cormorant        | <i>Phalacrocorax carbo</i>         | 23. Common Moorhen            | <i>Gallinula chloropus</i>       |
| 3. Little Cormorant       | <i>Phalacrocorax niger</i>         | 24. Purple Moorhen            | <i>Porphyrio porphyrio</i>       |
| 4. Spot-billed Pelican    | <i>Pelecanus philippensis</i>      | 25. Common Coot               | <i>Fulica atra</i>               |
| 5. Large Egret            | <i>Casmerodius albus</i>           | 26. Pheasant-tailed Jacana    | <i>Hydrophasianus chirurgus</i>  |
| 6. Purple Heron           | <i>Ardea purpurea</i>              | 27. Black-winged Stilt        | <i>Himantopus himantopus</i>     |
| 7. Grey Heron             | <i>Ardea cinerea</i>               | 28. Red-wattled Lapwing       | <i>Vanellus indicus</i>          |
| 8. Indian Pond Heron      | <i>Ardeola grayii</i>              | 29. Black-tailed Godwit       | <i>Limosa Limosa</i>             |
| 9. Cattle Egret           | <i>Bubulcus ibis</i>               | 30. Marsh Sandpiper           | <i>Tringa stagnatilis</i>        |
| 10. Median Egret          | <i>Mesophoyx intermedia</i>        | 31. Common Greenshank         | <i>Tringa nebularia</i>          |
| 11. Little Egret          | <i>Egretta garzetta</i>            | 32. Common Sandpiper          | <i>Actitis hypoleucos</i>        |
| 12. Painted Stork         | <i>Mycteria leucocephala</i>       | 33. Little Ringed Plover      | <i>Charadrius dubius</i>         |
| 13. Asian Openbill-Stork  | <i>Anastomus oscitans</i>          | 34. River Tern                | <i>Sterna aurantia</i>           |
| 14. Oriental White Ibis   | <i>Threskiornis melanocephalus</i> | 35. Lesser-pied Kingfisher    | <i>Ceryle rudis</i>              |
| 15. Northern Pintail      | <i>Anas acuta</i>                  | 36. Small Blue Kingfisher     | <i>Alcedo atthis</i>             |
| 16. Common Teal           | <i>Anas crecca</i>                 | 37. White-breasted Kingfisher | <i>Halcyon smyrnensis</i>        |
| 17. Spot-billed Duck      | <i>Anas poecilorhyncha</i>         | 38. Paddyfield Pipit          | <i>Anthus rufulus</i>            |
| 18. Northern Shoveller    | <i>Anas clypeata</i>               | 39. Yellow Wagtail            | <i>Motacilla flava</i>           |
| 19. Garganey              | <i>Anas querquedula</i>            | 40. Grey Wagtail              | <i>Motacilla cinerea</i>         |
| 20. Common Pochard        | <i>Aythya ferina</i>               | 41. White Wagtail             | <i>Motacilla alba</i>            |
| 21. Western Marsh Harrier | <i>Circus aeruginosus</i>          | 42. Large Pied Wagtail        | <i>Motacilla maderaspatensis</i> |

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## Wadhvana a Wetland of International Significance

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In recent years wetland ecosystems are increasingly recognized and due importance is given to find out its fauna-and flora, especially Avifauna. Several studies are initiated to recognize a wetland either as a Ramsar site, or a wetland of National significance or a Sanctuary or a Community reservoir. One of such important but less studied site is Wadhvana located about 45 kilometers Southeast of Vadodara. It is an irrigation dam, which supports thousands of birds during migratory season. Eighty two species of water dependent birds has been listed from this area out of which 5 species are near threatened and one species is vulnerable and the total population reaches about 40 to 50 thousands during peak migratory season Dec- Jan month. A tremendous increase is seen in bird populations after regular post winter inundation of the reservoir with Narmada water.

In the present study annual changes in the bird communities are evaluated with reference to declaring it as a Ramsar site or a wetland of national significance. Wadhvana was visited twice in a month and every time bird census was carried out. To find out preference of dam by various groups of birds during various seasons, the birds were divided into 3 groups. Groups;- one: Grebes, Cormorants, Coots, two: ducks, three: shore birds. The species richness, species diversity equitability and relative abundance are calculated for total Number as well as individual

groups. It has been observed that species diversity were maximum during the month of January when most of the migratory birds arrive. The diversity of group one was more or less constant through out the year as the group includes all residential birds. However, the density decreased in the month of June to August as water the level is extremely high (due to flood condition in Gujarat June 2005). The occurrence of group 2 and 3 was also very low in these months and as expected the number of birds in group 1, 2 and 3 are maximum during the month of January, as there was a huge aggregation of migratory and resident species of birds. The reservoir is also used for fish culture which provides ample food to piscivorous birds.. From the data collected it can be seen that Wadhvana is important wetland for migratory, residential species of ducks, waders and divers. During winter and early summer large gathering of Nakta (*Sarkidiornis melanotos*) is observed (160-200). The percentage of some of the migratory birds has been observed to increase during post winter period February-March when the other small water bodies starts drying. These late migrating species were observed in the pond till April. Few other species which migrate early from south use the pond as a stop during early summer. The percentage of occurrence as well as species richness of waders were high in month of April, Wadhvana supports large number of birds during summer.

# Diversity, Richness and Monitoring of Waterbirds at the First Conservation Reserve of the Country (Asan Wetland, Uttaranchal, India)

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## Introduction

The Asan wetland, near village Dhalipur, 38 km from Dehra Dun, is located at the confluence of Yamuna Hydrel Canal and river Asan (a small rain fed tributary of the Yamuna River). Following are its salient features:

- + State: Uttaranchal
- + District: Dehra Dun
- + Coordinates: 30° 25' 60" N, 77° 42' 00"E
- + Ownership: Irrigation Department
- + Area: 250 ha
- + Altitude: 400m
- + Rainfall: 2,500 mm
- + Temperature: 140 C to 380 C
- + Biogeographic zone: Gangetic Plain
- + Habitats: Freshwater Reservoir
- + Declared as "**Asan Conservation Reserve**" by Government of Uttaranchal vide notification No. 2414(1)/X-2-2005-19(1)/2004, dated Dehra Dun, August, 5, 2005.
- + Under section 36A of The Wildlife (Protection) Act 1972, effective from 1.4.2003 "*the State Government may, after having consultation with the local communities, declare any area owned by the Government, particularly the areas adjacent to National Parks and Sanctuaries and those areas which link one protected area with another, as a conservation reserve for protecting landscapes, seascapes, flora and fauna and their habitat.*"
- + IBA Site code: IN-UT-01 under the category of Congregatory IBA sites

## Observations

- + To conserve the wetland habitats along the Yamuna and Asan rivers confluence,

- + To conserve and provide protection to the migratory waterbirds in the Conservation reserve.
- + To provide the legal framework to achieve the above.
- + To involve people in management and provide an opportunity of local employment with the help of conservation activities.

## Results and Discussion

Asan provides an ideal habitat for a large number of resident waterbirds as well as migratory waterfowl from across the Himalaya during winter season. During winter the average waterfowl count goes upto 6,000, with high species diversity, with dominant species like, Brahminy Duck, Mallard, Red-crested Pochard, Common Pochard, Tufted Pochard, Common Teal, Wigeon and Shoveller, etc. The total waterbird species recorded so far are 66 (33 winter migrants, 4 summer migrants, 15 local migrants and 14 residents). These can be broadly grouped into 13 categories:

|                         |              |
|-------------------------|--------------|
| 1. Dabbling Ducks       | : 11 species |
| 2. Diving Ducks         | : 8 species  |
| 3. Waders               | : 8 species  |
| 4. Storks               | : 4 species  |
| 5. Ibises               | : 1 species  |
| 6. Geese                | : 2 species  |
| 7. Water Crows          | : 3 species  |
| 8. Lapwings and Plovers | : 10 species |
| 9. Active Swimmers      | : 4 species  |
| 10. Stilts and Avocets  | : 2 species  |
| 11. Rails and Coots     | : 4 species  |
| 12. Jacanas             | : 2 species  |
| 13. Gulls and terns     | : 7 species  |

**Criteria under Ramsar convention:** Asan Reservoir fulfils the following criteria to give it the status of wetland of International importance:

**I. Globally Threatened Birds species (A1, A2, B1, B2, B3, C1, C2, D1, D2, E)**

***Critically Endangered (CR)***

1. Oriental White-backed Vulture
2. Slender-billed Vulture

***Vulnerable(VU)***

3. Marbled teal
4. Baer's Pochard
5. Pallas's Fish-eagle
6. Greater Spotted Eagle

***Near Threatened (NT)***

7. Darter
8. Painted Stork
9. Black-necked Stork
10. Oriental white Ibis
11. Ferruginous Pochard
12. Black-bellied Tern

**II. 1% Biogeographic population (A4i criteria)**

One of the best sites for Brahminy Shelduck congregation. 1% threshold of the species is 500. The population at Asan exceed the threshold four times (more than 4%) reaching > 2000.

***Assessment and monitoring of Asan Conservation Reserve***

The change analysis in Asan Reservoir was done during 1996-97 and 1997-98 using remote sensing

technique for understanding the correlation between the waterfowl populations and the change in the waterfowl habitat parameters namely land cover classes.

So far a positive relationship was indicated between the vegetation cover and waterfowl population.

***Conservation Issues***

- ✦ **Spread of weeds:** Several factors are currently contributing to the degradation of the habitat. The rapid spread of *Typha*, *Ipomea* and *Eichhornia* is a serious problem as no serious action is being taken for their eradication. There is acute erosion in catchment areas of both Yamuna and Asan R., resulting in rapid siltation of the reservoir.
- ✦ **Closure of Reservoir at wrong time:** The water management scheme of Irrigation department is unfavourable for migratory waterfowls. Often the barrage is drained in winter for repair and maintenance when it is having maximum population of migratory waterfowls, forcing them to abandon the wetland and subject to displacement and poaching. This should be deferred to till 15<sup>th</sup> March, whenever undertaken.
- ✦ **Non-sustainable tourism:** The Garhwal Mandal Vikas Nigam (GMVN) Ltd. promotes the site for water sports, which causes disturbance to waterfowls. Plying of Motor boats should be restricted from 15<sup>th</sup> October to 15<sup>th</sup> March.
- ✦ **Poaching:** Sporadic poaching takes place away from the main reservoir. Posting of forest guards, at least during key winter months can check this.

# Studies on Bird Diversity of Anekere Wetland of Karkala, Udupi District, Karnataka.

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## Introduction

Wetlands are highly complex water and land interactive systems and are supposed to be the most fertile and productive ecosystems in the world. Wetlands constitute a treasury of Biodiversity. The social demand and dependence on the wetlands provides an unaccountable economic value to such habitats. Due to inadequate attention and ignorance of common man, wetlands were referred as wastelands in the past leading to its disappearance in the process of urbanization and development. The Ramsar convention, which came into force in December 1973, demands an urgent need to develop the conservation strategies and management plan by inventorying, monitoring and documenting the diversity and density of Biodiversity with special reference to water fowl.

Anekere pond, the study area is at Karkala town, of Udupi District, Karnataka State at the foot hills of Western Ghats. It is about 35 Kms from Udupi, located at 13° North Latitude and 75° East Longitude. The altitude is about 300 meters. The average rainfall is about 5500mm per annum and the temperature ranges from 19° to 38°C. Anekere wetland is a manmade pond covering an area of about 25 acres. It was built by Pandyaadeva of Bhiravarasu dynasty in 1262 AD. The pond acted as a main source of ground water, recharging neighboring wells and bore wells and are used for irrigation. It has attracted human attention by its rich avifauna. The pond is under the protection of Basadi (Jain Temple) located in the center.

Anekere is the habitat of plenty of local and migratory waterfowls. Recently, human activities in catchments area and weed infestation in the pond has curtailed the water holding capacity and pulverized the flora of the pond. It has affected the waterfowls to a maximum extent. This study aims at inventorying the seasonal changes in diversity and density of waterfowls in the pond over a period of one year.

## Material and Methods

Inventorying water fowls diversity and density is taken up along with water quality analysis, plankton,

macrophytes and other fauna of the pond. The pond was weekly made for visited about a year and an average of 4 weeks was accounted for a month. Waterfowl population was enumerated by point count, look and see methods (Colin *et.al.*, 1992 ) Binoculars were used to see the birds. Waterfowls were identified by referring the key provided. (Salim Ali, 1996 and Bharath Bhushan *et.al.* 1993).

This work was carried out for the period of one year from July 2004 to June 2005. Water fowl population was observed and documented every weekend in the morning hours. The relative abundance of birds was estimated and their vacillation in different month of the year was recorded.

## Results and discussion

Reduction in the water retention in the pond and weed infestation has altered the ecological characteristics of the pond. The waterfowl species density and diversity was found to be more than the earlier records of (Achar, 1996). However the statistics show a wide difference in the water fowl population over the year. Some of the birds inhabiting the pond earlier like Coot and Ringed plovers were not recorded. Birds like Open bill Stork are the new entry in the chick list.

Since the Anekere pond is getting dried up in summer and being polluted by dumping the solid wastes, the bird life in the pond is threatened. Recently a mega project of weed eradication was taken up by the Rotary Club of Karkala, with the aid of funding agencies and construction of bunds is initiated. However the water fowls yet to identify the pond, a comfortable habitat.

The study conducted in one year from July 2004 to June 2005 has shown that the diversity and density of avifauna was proportional throughout the year.(Table1 & Graph1). It was evident that the water fowl population was found to be maximum in the month of December. The moderate volume of water storage, favorable temperature availability of food and the visit of migratory birds may be the cause for maximum population. As there are cultivated fields around Karkala, most of the birds are displaced in rainy season. It has been observed that the bird population was minimum in the month of August and steadily increase there on till December.

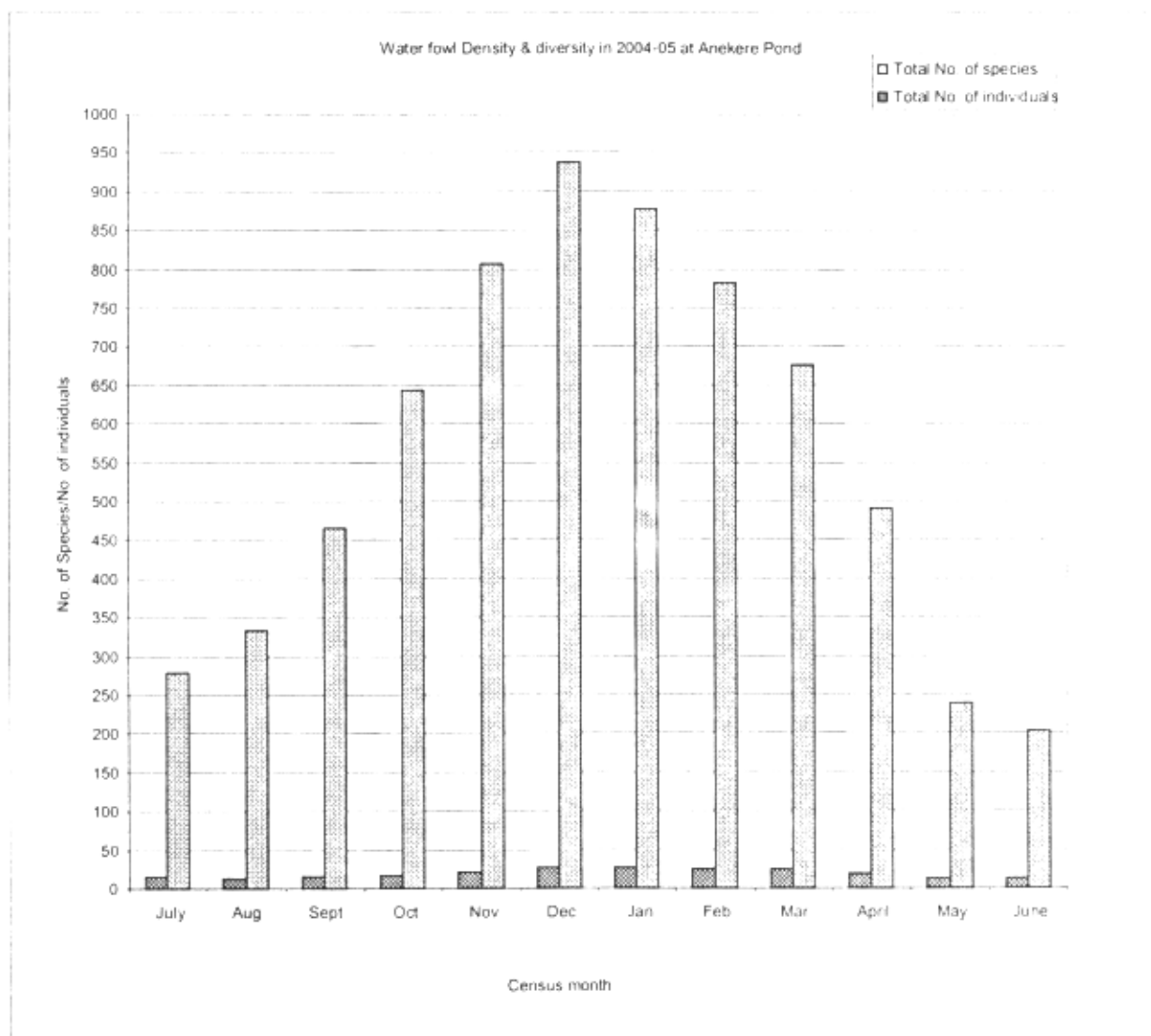
In the same way the population gradually decrease from December to June as the pond get dried up in summer. The pond is getting dried up by May and it drives away the avifauna. Even though the rainy season begin in the month of June, it is proved from the observation that the birds require a month or so to return to their habitat, the Anekere pond.

### Conclusions

The present study provides the population dynamics of Anekere pond over the year. It has been proved that the altered ecological characteristics of the pond

by siltation, pollution and weed infestation made the birds unable to inhabit throughout the year. In the recent years, large number of Purple Moorhens are inhabiting the pond recently. Whether these birds are indicators of weed infestation and increased vegetation, is a matter of debate. To conclude, December was found to be most favorable to Avifauna of Anekere pond. An assessment of current ecological status of Anekere pond is to be made and adequate measures to restore its original features are to be initiated to make the pond an abode of waterfowl.

**Fig 1. Graph Showing the diversity and density of water fowl from July 2004 to June 2005**





**TABLE 1: Water fowls and water dependant birds of Anekere Pond - Monthly Census.**

| Sl. No. | Name of the species       | No. of individuals in 2004-05 |     |      |     |     |     |     |     |     |       |     |      |
|---------|---------------------------|-------------------------------|-----|------|-----|-----|-----|-----|-----|-----|-------|-----|------|
|         |                           | July                          | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | April | May | June |
| 1       | Lesser Whistling Teal     | 170                           | 200 | 290  | 460 | 545 | 600 | 550 | 470 | 400 | 290   | 100 | 85   |
| 2       | Large Whistling Teal      | -                             | -   | -    | -   | 4   | 6   | 9   | 10  | 9   | 6     | -   | -    |
| 3       | Purple Moorhen            | 22                            | 40  | 50   | 65  | 90  | 92  | 90  | 86  | 75  | 60    | 31  | 28   |
| 4       | Bronze-winged Jacana      | 23                            | 28  | 33   | 29  | 40  | 42  | 40  | 38  | 37  | 35    | 23  | 22   |
| 5       | Pond Heron                | 18                            | 18  | 34   | 25  | 30  | 45  | 40  | 37  | 35  | 32    | 24  | 20   |
| 6       | Darter                    | -                             | -   | -    | 2   | 2   | 2   | 2   | -   | -   | -     | -   | -    |
| 7       | Little Cormorant          | 2                             | 3   | 1    | 3   | 2   | 4   | 4   | 3   | 2   | 2     | 2   | 2    |
| 8       | Little Grebe              | -                             | -   | -    | -   | -   | 12  | 12  | 11  | 6   | 2     | -   | -    |
| 9       | Grey Heron                | -                             | -   | -    | 1   | 2   | 2   | 2   | 2   | 2   | 1     | -   | -    |
| 10      | Night Heron               | -                             | -   | -    | -   | -   | 2   | 1   | 2   | -   | -     | -   | -    |
| 11      | Green Heron               | 1                             | 1   | 2    | 4   | 3   | 5   | 4   | 5   | 2   | 2     | -   | -    |
| 12      | Little Egret              | 8                             | 11  | 15   | 12  | 18  | 16  | 18  | 14  | 11  | 5     | 2   | 3    |
| 13      | Median Egret              | 3                             | 5   | 6    | 9   | 14  | 19  | 12  | 9   | 4   | 2     | 1   | 2    |
| 14      | Cattle Egret              | 2                             | 1   | 1    | 3   | 6   | 5   | 8   | 7   | 5   | 2     | 1   | -    |
| 15      | Cotton Teal               | -                             | -   | -    | -   | -   | 16  | 14  | 10  | 8   | -     | -   | -    |
| 16      | Common Teal               | -                             | -   | -    | -   | -   | 9   | 10  | 8   | 6   | 4     | -   | -    |
| 17      | White-breasted Waterhen   | 3                             | 2   | 5    | 3   | 2   | 6   | 4   | 5   | 3   | 4     | 1   | 1    |
| 18      | Open-bill Stork           | -                             | -   | -    | -   | 4   | 4   | 4   | 4   | 4   | 4     | 2   | -    |
| 19      | Common Snipe              | -                             | -   | -    | -   | -   | 5   | 8   | 8   | 6   | -     | -   | -    |
| 20      | Red-wattled Lapwing       | -                             | -   | -    | -   | -   | -   | -   | -   | 4   | 4     | 6   | 6    |
| 21      | Common Sandpiper          | -                             | -   | -    | -   | -   | 3   | 4   | 4   | 2   | -     | -   | -    |
| 22      | Small Blue Kingfisher     | 3                             | 1   | 4    | 2   | 4   | 5   | 4   | 5   | 4   | 3     | 1   | 2    |
| 23      | Pied Kingfisher           | 4                             | -   | 3    | 1   | 4   | 3   | 4   | 2   | 1   | -     | -   | 1    |
| 24      | Stork Billed Kingfisher   | 1                             | 2   | 1    | -   | 2   | 1   | 2   | 2   | -   | -     | -   | -    |
| 25      | White-breasted Kingfisher | 1                             | 1   | 2    | 1   | 2   | 2   | 2   | 1   | 2   | -     | -   | -    |
| 26      | Green Bee-eater           | 18                            | 20  | 12   | 16  | 20  | 18  | 22  | 20  | 20  | 12    | 14  | 11   |
| 27      | Common Swallow            | -                             | -   | 6    | 8   | 12  | 12  | 16  | 20  | 18  | 20    | 20  | 20   |
| 28      | White-necked Stork        | -                             | -   | -    | -   | -   | 2   | -   | -   | -   | -     | -   | -    |
|         | Total No. of species      | 15                            | 13  | 16   | 17  | 20  | 27  | 26  | 25  | 24  | 19    | 14  | 13   |
|         | Total No. of individuals  | 279                           | 333 | 465  | 643 | 806 | 938 | 876 | 783 | 676 | 490   | 238 | 203  |

# Avifauna of the Dr. Salim Ali Bird Sanctuary at Chorao – an Estuarine Wetland of Goa, India

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## Introduction

Tropical estuarine wetlands serve as ideal wintering grounds and stopover points for millions of wintering waterbirds owing to their strategic locations and rich prey potential (Davis and Smith, 1998). Barbosa (1997) recognized that in the absence of tropical wetlands, the complex phenomenon of waterbird migration would cease to exist. In India, although a considerable amount of wetland research has been conducted, it has centered around few large, more important wetlands (Wolstencroft et. al., 1989), particularly the RAMSAR sites. As such many of the poorly studied yet potentially important smaller 'satellite wetlands' that provide an alternative resource to millions of waterfowl remain totally neglected and are under great pressure from industrialization and anthropogenic activities (Bendell-Young, et. al. 2000). Dr. Salim Ali Bird Sanctuary at Chorao, is one such small yet potentially important estuarine wetland that was declared a protected mangrove forest in 1988. However, although this is the only sanctuary in Goa, until the culmination of this work, information regarding its avifauna was available only in the form of opportunistic tourist checklists with no ecological impetus.

Waterbirds, being generally at or near the top of most wetland food chains are highly susceptible to habitat disturbances and are therefore good indicators of the general condition of wetland habitats (Kushlan, 1992). They also play a crucial role in mass and energy fluxes between terrestrial and aquatic food chains (Moreira, 1997). Hence, it becomes all the more pertinent to study the ecology and avian community structure from a totalitarian scientific perspective so as to plan a proper management plan for the conservation of any wetland sanctuary.

Pintail ducks constitute a major component of the waterfowl population of India. Walia (2000) reported that large flocks of migrant Pintail Ducks used the Carambolim Lake in Goa as a habitat during brief intervals. However their alternative habitat and foraging ground in the state were unconfirmed. There were also popular reports as to the occasional presence of large flocks of these anatids in the Mandovi estuary, which were neither confirmed nor

ruled out (Walia and Shanbhag, 1996, Shanbhag et. al., 2001). Hence, the present paper aims at providing baseline data on the avifaunal community structure of the only bird sanctuary of the state in addition to understanding the prey preferences of the birds. Further, an attempt has also been made to understand the utility of the Chorao sanctuary by the pintail Ducks

## Study Area

The Mandovi estuary, one of the major component of the Mandovi-Zuari estuarine complex (15°25' to 15°31' N and 73°45' to 73°59'E), lies in the Northern district of Goa. Chorao, the largest of the 5 deltaic accretion islands studding the estuary houses the Dr. Salim Ali Bird Sanctuary covering an area of 1.8 Km<sup>2</sup>. The sanctuary region comprises of dense mangrove forests and is interrupted only by a number of small water streams winding their way into the sanctuary. These sand/mudflats and mangrove belts are under the continuous influence of alternate submergence and exposure all through the high/low tides, hence truly fitting in the category of estuarine wetlands. The vegetation of Chorao comprised of dense mixed mangrove trees showing some level of succession. *Rhizophora mucronata*, *Avicennia marina*, *A. officinalis*, *Kandelia kandel*, *Sonneratia alba*, *Excoecaria agallocha*, *Bruguiera parviflora*, and *Acanthus ilicifolius* were the common species. The drier parts of the estuarine wetlands were dominated by *Caesalpinia nuga*.

## Material and Methods

The sediment for the analysis of benthic biota were collected at monthly intervals from 3 predetermined sampling spots on the exposed mudflats of the sanctuary by adopting the core sampling technique (Holme & McIntyre, 1971). The sediments were pooled and mixed together in a polythene bag and immediately fixed with 10% formaldehyde containing Rose Bengal stain. After 48 hours of fixation the sediment was subjected to sorting through test sieves under running tap water. The isolated fauna was identified using taxonomic literature (Fauvel, 1932; Edmondson, 1959; Brusca, 1980).

The bird community on the exposed mudflat was scanned at fortnightly intervals from an indigenous

dug out canoe with an onboard motor (0.5Hp Honda engine), moving at uniform speed of 10km per hour. Foot trails were conducted into the dense mangroves not accessible by boat and the birds therein were listed. The birds sighted were identified using relevant field guides (Woodcock, 1980; Ali & Ripley, 1983; Sonobe & Usui, 1993; Grewal, 1995; Ali, 1996; Grimmett *et. al.* 1998). A combination of Total Count Method and Linear Transact count method standardized to meet the requirements of the site were employed. An 8x35 and 12 ' 25 binoculars' and a 15-45x60 spotting scope was used for the purpose.

The climate of Goa is strongly influenced by the southwest monsoon occurring normally from June to September. However, since the present study is vortexed around waterbird ecology the seasons have been categorized as summer, extending from March to May; monsoon from June to September, post monsoon from October to November and winter from December to February.

The species diversity and equatibility were calculated using standard formulae (Pielou 1975) and species richness was computed using Margalef's species richness index (1968). All data was  $\log_{10}$  transformed to meet the requirements of parametric tests. The correlations between the parameters was statistically analysed by calculating the Pearson bivariate correlation coefficient 'r'. Monthly variations in the feeding guilds as well as in the populations of waterbirds, waders and terrestrial birds were analysed by One-Way ANOVA followed by the Tukey-HSD multiple range test. Seasonal variations in the above were analysed by non-parametric Kruskal-Wallis One-Way ANOVA. All statistical analysis were performed in SPSS (version 7.5.1 for windows) with the alpha probability level set at 0.05.

## Results and Discussion

The benthic fauna of all Chorao comprised of 31 species spanning across 4 major groups namely nematodes, polychaetes, crustaceans and mollusks. Seasonal variations in the benthic macroinvertebrate densities are given in Table 1.

Polychaetes were the most dominant, constituting 57.43% of the benthic fauna in terms of density. On a seasonal basis their densities were highest in monsoon, but dropped to significantly low levels in post monsoon. ( $\chi^2=6.7$ ,  $df=3$ ,  $p=0.08$ ). Polychaete fauna was largely dominated by Neriids, maldanids and spionids. Nematodes were the second most dominant component of the benthic fauna, constituted 33.15% followed by crustaceans with a mere 4.53%.

The nematodes, polychaetes and crustaceans together constituted the soft-bodied forms and were easily available to the benthivorous waders. Their collective density was lowest in late post monsoon but increased progressively to attain a peak in late summer. This sharp decline in the soft bodied fauna in post-monsoon and early winter coincided with the high avian species richness ( $SR=9.32$ ) owing to the influx of migrant waders.

Chorao harbored as many as 115 species of birds of which 59 species were of terrestrial birds. On the whole the cumulative biannual bird population Chorao was 53,381 individuals. Although the species diversity of terrestrial birds was relatively high they contributed a mere 23.08% to the total avifaunal population. The terrestrial birds dominating the estuarine mangroves included Greenish Leaf Warbler, *Phylloscopus trichiloides*; Blyth's Reed Warbler, *Acrocephalus dumetorum*; Indian Great Reed Warbler, *A. stentoreus*; Redwhiskered Bulbul, *Pycnonotus jocosus*; Black capped Kingfisher, *Halcyon pileata*; Blue-eared Kingfisher, *Alcedo meninting* and Collared Kingfisher, *Todiramphus chloris*. The 3 species of Kingfishers were recorded exclusively inside the Chorao sanctuary indicating that although the sanctuary is an estuarine wetland, it provides an ideal habitat even for terrestrial birds that feed largely on insects.

The waterfowl community of Chorao was constituted by 56 species including both, residents and migrants, the latter far exceeding the former. In terms of population the biannual cumulative total of the waterbirds alone was 47,169. Anatids, ciconids, ardeids, charadriids and larids were the 4 dominant groups. While the ciconids recorded in the region were migrants all the ardeids were residents. Large Egret, *Casmerodius albus*; Little Egret, *Egretta garzetta* and Cattle Egret, *Bubulcus ibis* were observed to breed in the sanctuary. Reef Egret, *Egretta gularis*; Asian Openbill Stork, *Anastomus oscitans*; White-necked Storks, *Ciconia episcopus* and Lesser Adjutant Storks, *Leptoptilos javanicus* were the wading birds inhabiting the wetland. Among the anatids the migrant Pintails, *Anas acuta* were observed actively foraging on the mudflats in extremely large flocks of upto 7,000 individuals per encounter thereby confirming the speculations of Walia (2000).

The waders constituted the largest and most diverse chunk of the waterbird community of the sanctuary. The group was largely dominated by 3 families namely charadriidae, scolopacidae and glareolidae. Redshanks, *Tringa tetanus*; Little Stints, *Calidris minuta*; Curlew Sandpipers, *Calidris ferruginea*; Ruff,

*Philomachus pugnax*; Common Sandpiper, *Actitis hypoleucos*; Curlews, *Numenius arquata*; Lesser Sandpipers, *Charadrius mongolus*; Greater Sandpipers, *Charadrius leschenaultii* and Kentish plovers, *Charadrius alexandrinus* were the regular winter visitors that formed the bulk of the migrant population. The waders used the estuarine mudflats largely as a foraging ground and were observed feeding actively in the soft sediment. Among the larids Brown-headed Gulls, *Larus brunnicephalus*; Black-headed Gulls, *Larus rudibundus*; Gull-billed Terns, *Gelochelidon nilotica*; White-cheeked Terns, *Sterna repressa* and River Terns, *Sterna aurantia* dominated.

The significant correlation observed between pintail ducks and crustacean density ( $r=0.96$ ,  $p<0.01$ ) was in consonance with the field observations indicating that crustaceans constituted an important prey item of the ducks. On the other hand a negative correlation between waterbirds and nematodes ( $r=-0.462$ ,  $p<0.05$ ) explains the decrease in the nematode density during peak migration while a highly significant correlation between the terrestrial birds and the insectivores ( $r=0.983$ ,  $p<0.01$ ) highlights that a majority of the birds inhabiting the mangrove canopy were insectivores.

A negative correlation observed between waterbirds and terrestrial component ( $r=-0.521$ ,  $p<0.05$ ) was because most of the terrestrial birds were residents while the waterbirds were migrants. In terms of

seasonality a distinctly significant seasonal variation was observed among the benthivores, frugivores, herbivores comprising exclusively of pintails and piscivores as well as between the waterfowl, waders and terrestrial birds has been shown in table 1. In general, across the 2 years of study, the populations of herbivores and benthivores were significantly higher than the other groups ( $df=139$ ,  $F=24.646$ ,  $p=0$ ).

The avian species diversity ranged from 2.05 to 3.13 while the species richness ranged from 7.7 to 9.32. Species evenness however remained between 0.5 to 0.82 all through the year. The seasonal variations in the bird species indices have been shown in Table 2.

Thus, the findings suggest that the Dr. Salim Ali Bird Sanctuary at Chorao is home for a large number of both wetland birds as well as terrestrial birds some of which are exclusive to the sanctuary. The mangrove sanctuary also provides an ideal foraging ground and a stopover point for numerous waterbirds particularly waders and pintails. Therefore, all out steps need be taken to protect and preserve the sanctuary, the only one in the state.

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**Table 1:** Seasonal variations in the density of benthic macroinvertebrates and the community structure of the avifauna of Dr. Salim Ali Bird sanctuary at Chorao, Goa.

|                                                       | Summer     | Monsoon    | Post-Monsoon | Winter                                                        |
|-------------------------------------------------------|------------|------------|--------------|---------------------------------------------------------------|
| <b>BENTHIC MACRO INVERTEBRATES(ind/m<sup>2</sup>)</b> |            |            |              |                                                               |
| Nematodes                                             | 1299 ± 292 | 667 ± 23   | 915 ± 137    | 492 ± 80                                                      |
| Polychaetes                                           | 2017 ± 391 | 2113 ± 308 | 256 ± 46     | 1085 ± 380                                                    |
| Crustaceans                                           | 246 ± 19   | 52 ± 30    | 77 ± 36      | 63 ± 30                                                       |
| Soft-bodied forms                                     | 3638 ± 61  | 2808 ± 42  | 1247 ± 10    | 1620 ± 30                                                     |
| <b>AVIFAUNA (birds/encounter)</b>                     |            |            |              |                                                               |
| <b>Habit</b>                                          |            |            |              |                                                               |
| Waders                                                | 734 ± 173  | 78 ± 31    | 1009 ± 317   | <b>2207**</b> ± 261<br>( $\chi^2=9.76$ , $p=0.02$ , $df=7$ )  |
| Water birds                                           | 462 ± 328  | 64 ± 13    | 142 ± 27     | <b>3552**</b> ± 1197<br>( $\chi^2=9$ , $p=0.03$ , $df=7$ )    |
| Terrestrial Birds                                     | 197 ± 47   | 145 ± 37   | 323 ± 45     | <b>454**</b> ± 13<br>( $\chi^2=8.21$ , $p=0.04$ , $df=7$ )    |
| <b>Habitat</b>                                        |            |            |              |                                                               |
| Pintails/                                             | 338 ± 337  | 0          | 7 ± 5        | <b>3177**</b> ± 1025<br>( $\chi^2=8.78$ , $p=0.03$ , $df=7$ ) |
| Herbivores                                            |            |            |              |                                                               |
| Insectivores                                          | 192 ± 49   | 127 ± 34   | 324 ± 45     | 433 ± 14                                                      |

|             |           |         |           |                                                              |
|-------------|-----------|---------|-----------|--------------------------------------------------------------|
| Benthivores | 515 ± 119 | 69 ± 30 | 873 ± 234 | <b>1907**</b> ± 367<br>( $\chi^2=9.16$ , $p=0.03$ , $df=7$ ) |
| Frugivores  | 16 ± 3    | 27 ± 4  | 20 ± 5    | 6 ± 2                                                        |
| Piscivores  | 324 ± 67  | 56 ± 10 | 241 ± 104 | <b>654**</b> ± 57<br>( $\chi^2=9.03$ , $p=0.02$ , $df=7$ )   |
| Carnivores  | 8 ± 1     | 9 ± 1   | 9 ± 1     | 9 ± 1                                                        |

**Table 2:** Seasonal variations in the avifaunal species diversity (H'), equatibility (J') and richness (SR) of Dr. Salim Ali Bird sanctuary at Chorao, Goa.

|    | Summer | Monsoon | Post Monsoon | Winter |
|----|--------|---------|--------------|--------|
| H' | 3.03   | 2.84    | 2.94         | 2.18   |
| J' | 0.74   | 0.76    | 0.7          | 0.52   |
| SR | 8.63   | 7.49    | 9.32         | 7.7    |

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# Avian Life in Monoculture Plantations in Goa, India

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## Introduction

Monoculture plantations are uniform agro-eco systems that substitute natural ecosystems and their biodiversity. Plantations are believed to have severe negative environmental impacts (Shiva, 1993) causing serious loss of biodiversity (Pramod et. al. 1997). Birds are considered to be good indicators of ecological disturbances and hence birdlife is taken as a measure that can come handy in quantifying the quality of an environment in ecological planning as well as impact assessment (Parasharya, et. al., 1995).

An earlier study (Gray, 1974) suggested that monocultures can also serve to be better stands for avifauna. But Gandhi (1986) didn't endorse the view and recommended improvement strategies to ameliorate the negative consequences of monoculture, in the form of interplanting of few indigenous species to improve the biodiversity. Cruz (1988) opined that understory shrubs, vines and the upperstory of few native trees enhanced avian use of monoculture stands.

Monoculture practices in Goa largely fall in unmanaged category, wherein the regular management lasts for initial 2-3 years. Later the stands are left with least human indulgence. Hence neither the undergrowth nor a small number of native plants in the form of leftover saplings or later invasions are prevented from establishing in these areas. Hence, it was considered interesting to study the birdlife in some of these unmanaged monocultures such as teak, *Tectona grandis* (TP); cashew, *Anacardium occidentale* (CP) and Australian acacia, *Acacia auriculiformis* (AP) in comparison with natural forest (NF) as a control system.

## Material and Methods

Bird census were conducted at monthly intervals from March 2001 to February 2003. The avifaunal diversity and abundance was studied by Encounter Rate Method (Bibby et. al., 1992; Javed and Kaul, 2002). Observations were carried out using a 12 x 25 binoculars and identification was based on standard

field guides (Ali, 1996; Grimmett et. al., 1998). The study sites were carefully scanned for signs of breeding activities of the birds. Based on the actual foraging observations as well as the information from literature all the birds sighted were classified into 4 feeding guilds; insectivores, phytophages, omnivores and carnivores for further foraging guild related analysis.

## Study area

The study was carried out in Valpoi range at Sattari Taluka of North Goa forest Division of Goa (15° 48'2" to 14° 53'2" N & 74° 20'2" to 73° 40'2" E). In NF the dominant tree species were *Terminalia paniculata*, *T. tomentosa* and *Xylia xylocarpa*. *Clerodendron viscosum* was the dominant undergrowth species. The climate of Goa is warm and humid with temperature ranging from 20°C to 36°C and relative humidity ranging from 70-98%. Monsoon is a distinct season extending from June to September, experiencing a total annual precipitation of 2600 mm.

## Results and Discussion

Tables 1 and 2 give biennial picture of general and guild composition of bird community in natural forest and monoculture plantations. During the study period a total of 129 bird species were recorded in all the study sites put together. CP harbored 78 species of birds that were in close range of that housed by NF (80 species). The diversity in TP was marginally higher with 83 species while AP supported reasonably low diversity with only 69 species.

In terms of affiliation, the birds in TP as well as CP belonged to 9 orders and 27 families. Those in NF were more diverse belonging to 12 orders and 30 families. On the other hand the birds in AP had affiliation to only 7 orders and 27 families.

Three insectivorous species, Black Drongo, Greater Racket-tailed Drongo and Chestnut-bellied Nuthatch were the dominant species in the NF. In TP also the Black Drongo occupied the first rank, while the omnivore, Jungle Crow, and the nectarivore, Purple Sunbird followed the rankings in the site. In CP the omnivores - Red-whiskered Bulbul and Jungle Babbler



dominated, while the Purple Sunbird occupied the 3<sup>rd</sup> rank. In AP, Greater Racket tailed Drongo and Red-whiskered Bulbul acquired the first 2 ranks and the phytophage, Black-headed Oriole occupied the third place.

The bird abundance on biannual basis, in terms of encounter rate varied within extremely narrow range of 42.2 – 44.58 ind./ Km in all the 3 plantations, that was in turn close to that of the primary forest, being 44.75 ind./Km.

During the study period, 22 migrant species were sighted that included 7 distant migrants. NF harbored 15 migratory species. Among plantations TP supported maximum number of migrants (17 sps), followed by cashew (14 sps) and least in acacia (12 sps). Among the migrants a local migrant, Greenish Leaf Warbler occupied 1<sup>st</sup> rank in NF as well as AP and CP, but had a 2<sup>nd</sup> place in TP. Another local migrant, Eurasian Golden Oriole occupied the 1<sup>st</sup> rank amongst the migrants in TP.

The passerines in terms of abundance formed 86.9% of the bird fauna in NF, but was higher in plantations ranging from 89 to 91.6%. In terms of diversity, passerines constituted only 67% of the bird fauna in NF, but the guild was with higher representation in plantations ranging from 74.7-77.5%. The proportion of nonpasserines naturally was in reverse order, being higher in NF in abundance (13.1%) as well as in diversity (33%) compared to those in plantations.

Of the four feeding guilds, insectivores and phytophages dominated at all the study sites in abundance as well as in diversity. The insectivore abundance constituted 59.9% of the birds in NF, while it was lower in all the plantations, the difference being significant in CP ( $F = 7.29$ ,  $df=3$ ,  $pd^*0.001$ ). The diversity of the guild in NF was 53.6%. It was higher in TP (61%), marginally higher in AP (54.9%), but significantly lower in CP ( $F = 4.33$ ,  $df = 3$ ,  $pd^*0.01$ ). The omnivores in CP were represented by 10

species with mean abundance of 8.5 ind/ Km., that was significantly higher than all the study sites, in terms of abundance ( $F = 6.47$ ,  $df = 3$ ,  $Pd^*0.001$ ) as well as diversity ( $F = 5.61$ ,  $df = 3$ ,  $Pd^*0.001$ ).

During the two years of study breeding activities of 15 species of birds were registered in the study sites. Six species were found breeding in NF and five species each in all the three plantations. Red-whiskered Bulbul was found breeding in all the plantations, but not in NF. The Small Sunbird, *Nectarinia minima* an endemic species was observed to breed in TP. Of the six species of birds sighted to breed in NF, 5 (Lesser Spotted Eagle, Lesser Golden-backed Woodpecker, Yellow-browed Bulbul, White-rumped Munia ) showed exclusivity to the site. Only in TP.

The teak as well as cashew plantations supported avifaunal diversity almost in close range of that supported by natural forest. Even though the bird diversity at acacia plantation was the least, the difference was not statistically significant. Bird diversity in plantations on par with natural forest could be attributed to presence of undergrowth, few indigenous trees in the plantations owing to unmanaged practices, and also the close proximity of plantation to the primary forests. The findings are in conformity with the recommendations by earlier workers (Gandhi 1986, Cruz, 1988) for augmenting a better biodiversity in plantations.

The guild based analysis in the present study also showed that the natural forest harbored more carnivores and nonpasserines than in all the plantations. Therefore, the natural forest with extensive array of microhabitats, diverse and sustained food resource must be able to support forest specialists and carnivores generally occupying higher trophic levels. While, the forest generalists such as omnivores could find refuge in plantations. Sallying mode of foraging supported by launching perches along with an open view provided by deciduous teak trees might have

**Table 1 Biennial picture of general composition of bird community in natural forest and monoculture plantations.**

|                      | Natural forest | Plantations  |              |           |
|----------------------|----------------|--------------|--------------|-----------|
|                      |                | Teak         | Cashew       | Acacia    |
| Abundance ind/ km    | 44.75 ± 3.59   | 43.58 ± 4.15 | 44.58 ± 4.13 | 42.2 3.99 |
| Orders/ Families     | 12/30          | 9/27         | 9/27         | 7/23      |
| Total no. of species | 80             | 83           | 78           | 69        |
| Breeding             | 6              | 5            | 5            | 5         |

contributed for better insectivore abundance in teak plantation.

Of the 6 species of birds sighted to breed in NF, 5 exclusively bred at the site. The only Orange-headed Thrush that bred at NF also bred in TP. This amounts to the fact that some species needing specific requirements provided by NF for their breeding probably can't get easily adopted to altered

environments. Red-whiskered Bulbul was found to breed in all the plantations but not in natural forest, indicating that this generalist bird prefers altered habitat over natural forest.

In final analysis the monoculture forests in unmanaged state may be reasonably good in nurturing biodiversity though not comparable to natural forest in its totality.

**Table 2: Guild compositions of the bird community in natural forest and monoculture plantations.**

| Guilds       | Abundance(ER – Ind/km & percentage) |                         |                        |                         | Diversity(Total no. of species & percentage) |               |               |               |
|--------------|-------------------------------------|-------------------------|------------------------|-------------------------|----------------------------------------------|---------------|---------------|---------------|
|              | Natural                             | Teak                    | Cashew                 | Acacia                  | Natural                                      | Teak          | Cashew        | Acacia        |
| Resident     | 38.04 ± 3.12<br>(85%)               | 39.04 ± 3.86<br>(88.7%) | 42 ± 3.87<br>(90.9%)   | 36.7 ± 3.69<br>(87.6%)  | 67<br>(81.7%)                                | 70<br>(80.5%) | 66<br>(82.5%) | 59(83%)       |
| Migrant      | 6.7 ± 1.47<br>(15%)                 | 5 ± 1.01<br>(11.4%)     | 4.2 ± 0.99<br>(9.1%)   | 5.2 ± 1.32<br>(12.4%)   | 15<br>(18.3%)                                | 17<br>(19.5%) | 14<br>(18.5%) | 12<br>(16.9%) |
| Passerine    | 37.8 ± 4.09<br>(86.9%)              | 39 ± 3.86<br>(89%)      | 40.25±3.73<br>(91%)    | 39.12 ± 3.93<br>(91.6%) | 55<br>(67%)                                  | 65<br>(74.7%) | 62<br>(77.5%) | 55<br>(77.5%) |
| Nonpasserine | 5.7 ± 1.16<br>(13.1%)               | 4.83 ± 1.03<br>(11%)    | 4 ± 1.58<br>(9%)       | 3.58 ± 0.92<br>(8.4%)   | 27<br>(33%)                                  | 22<br>(25.3%) | 18<br>(22.5%) | 16<br>(22.5%) |
| Insectivores | 27 ± 3.22<br>(59.9%)                | 20 ± 2.19<br>(46%)      | 14.5 ± 2.45<br>(32.4%) | 1.85 ± 2.24<br>(42.4%)  | 44<br>(53.6%)                                | 53<br>(61%)   | 36<br>(45%)   | 39<br>(54.9%) |
| Phytophages  | 16.6 ± 1.82<br>(36.8%)              | 18.8 ± 2.57<br>(43.3%)  | 21 ± 2.64<br>(47%)     | 19.7 ± 2.2<br>(45.2%)   | 26<br>(31.7%)                                | 26<br>(29.8%) | 28<br>(35%)   | 26<br>(36.6%) |
| Omnivores    | 0.7 ± 0.24<br>(1.6%)                | 4.2 ± 0.9<br>(9.7%)     | 8.5 ± 1.27<br>(19%)    | 5.12 ± 1.12<br>(11.7%)  | 3<br>(3.6%)                                  | 2<br>(2.3%)   | 10<br>(12.5%) | 3<br>(4.2%)   |
| Carnivores   | 0.8 ± 0.34<br>(1.8%)                | 0.4 ± 0.15<br>(0.9%)    | 0.75 ± 0.24<br>(1.7%)  | 0.37 ± 0.14<br>(0.8%)   | 9<br>(11%)                                   | 6<br>(6.9%)   | 6<br>(7.5%)   | 3<br>(4.2%)   |

### Acknowledgement

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# Peacock Feeding on Crops and Their Conservation Issues in Karnataka

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## Introduction

Indian Peafowl (*Pavo cristatus* Linn.) is a widely distributed and at places locally abundant bird in the Indian subcontinent. Though it is a national bird and feeds on several crops is branded as "pest" in certain cropping situations, information on its diet is largely qualitative and incomplete (Mohan Kumar, 1998). Ali and Ripley (1987) and John Singh and Murali (1980) provided preliminary information on diet on peafowl.

The information presented here was obtained from surveys conducted in Koyoor, Belthangady villages (Belthangadi taluk), Durga, Umedabail, Kaliyadi, Kervase, Tellar, Sirlal and Mala villages (Karkala taluk,) Dakshina Kannada and Udupi districts from October 1998 to February 1999 and from October 2004 to August 2005. Observations recorded during the survey regarding feeding by peacocks and feeding damage assessment made are presented in this paper.

## Material and Methods

Peafowl feeding on different crop plants was assessed by visual observations of the crop damage presence of peafowl, its feathers and foot prints. Subsequently, 5 m<sup>2</sup> quadrates were randomly laid in the field and number of plants per clump (in paddy) damaged to the total number per 5 m<sup>2</sup> was counted and expressed in terms of percentage.

Number of birds foraging per unit cropped area was counted, frequency of occurrence and feeding behavior of birds in the fields were recorded. Farmers were interviewed using a format developed for the purpose on crop protection measures and attitude of growers towards the bird. Estimates on crop yield losses were also made to determine if feeding by peacocks resulted in economic losses to the growers. Data were subjected to appropriate statistical analyses.

## Results and Discussion

During the study period, 18 surveys were conducted in 10 villages of South Kanara and Udupi districts. Peafowl feeding on Cucurbit vegetables, Brinjal, Cowpea, Ladies finger, Pulses and Paddy were recorded. The details of crop damage village wise

are furnished in Table 1. Among different crops paddy was the dominant one damaged by Peafowl. Damage by birds was caused by trampling, lodging the tillers and by pecking grains and cutting the entire panicles. In Koyoor village 'Jyothi' cultivar of paddy was damaged at the edge along the bunds. Birds were observed roosting on trees in the uplands adjacent to paddy fields. The bird caused damage throughout the year. However, peacock damage occurred during August-September.

The population of birds in the fields of different crops, generally varied from 2-3 in about 5-10 acres of crops. The farmers reported that breeding in these birds occur during October-November. The clutch size in the peacocks varied from 2-3 eggs. As evidence from interviews conducted with growers, the crop damaged by these birds is increasing year after year probably due to increase in local bird populations. The foraging area of the peacocks in the region is also expanding to the neighboring districts. The public due to religious sentiments are protecting the birds. Birds are worshipped as Vahana of Lord Kumaraswamy. The birds are not been killed and instead they are worshipped. Secondly, the peacocks are predators on snakes and leeches. Thirdly, these birds are beautiful and people do not wish to kill these birds.

The birds in the Kudremukh wildlife sanctuary and other forest areas are freely breeding as they have no predators such as tigers and leopards. These factors are responsible for local population build up. Albeit, few individuals are being killed by hill tribes for extracting oil which is of medicinal value.

In none of the villages surveyed, farmers are keen to take up any crop protection measures. The crop field surrounding the northern sides of Kudremukh national park and other forest areas are being severely (50%) damaged. In these crop fields' crop protection measures are desired. During the peak feeding period the birds may be chased away. One farmer in Durga village used trained dogs to indicate the entry of birds to the fields. The bird landing and the movements in the field could be obstructed by springs of thorny bushes at strategic points.

In Gir forest of Gujarat, the diet of peacocks was dominated by seeds of *Zizyphus mauritiana* and *Z. oenopia* during winter i.e. December and January (Mohan Kumar, 1998). According to Giest (1997), the Indian peafowl is an opportunist that occupied the highly productive ecotone between forest and water, and thus evolved gregariousness and less aggressive behavior. In order to protect crops, farmers are leaving seeds of their crops with pesticides, resulting in the death of the birds. Timmapur (2005) reported death of peacock as a result of feeding on maize seeds

with endosulfan. On 8<sup>th</sup> July 2005, in the near by Pallikoppa village, Hubli, Karnataka, 25 peafowl and their young ones died when they ate jowar grains sprinkled with rat poison. With peafowl a host of other insectivorous and graminivorous birds and other beneficials in agroecosystems are suffering endless tribulations (Sridhar, 2005). However, in South Kanara and Udupi districts, farmers are conserving the birds and few farmers are protecting the crop without harming them.

**Table 1 Peacock damage to paddy during 2001 – 2004 in parts of Coastal Karnataka**

| Village         | Plot area (acres) | % damage | Yield loss (Kg) | Remarks                                                                                     |
|-----------------|-------------------|----------|-----------------|---------------------------------------------------------------------------------------------|
| Koyoor          | 06                | 08       | 80              | Damage occurred along the periphery, no. of birds 2-20                                      |
| Umedabaili      | 04                | 10       | 60              | Damage only at the borders, grain picking, no. of birds 2-3                                 |
| Kaliyadi        | 10                | 5        | 80              | Damage only at the borders, grain picking, no. of birds 2-3                                 |
| Sirlal          | 02                | 18       | 40              | Damage in patches, panicles swallowing, no. of birds 2-3                                    |
| Durga           | 02                | 15       | 40              | Damage in patches in all places. panicles swallowing, no. of birds 4-5                      |
| Mundali jarkala | 01                | 20       | 120             | Damage in patches, group feeding, trampling, lodging, and panicle cutting, no. of birds 2-3 |
| Hankibetta      | 0.5               | 8        | 40              | Damage in patches group feeding, trampling, lodging, and panicle cutting, no. of birds 4-6  |
| Kervase         | 02                | 12       | 100             | Damage in patches group feeding, trampling, lodging, and panicle cutting, no. of birds 5-6  |
| Mala            | 04                | 14       | 78              | Damage in patches group feeding, trampling, lodging, and panicle cutting, no. of birds 8    |
| Udupi           | 02                | 08       | 35              | Damage in only peripheral area, trampling, lodging, no. of birds 6                          |

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# Feeding Potential of Two Species of Vultures

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## Introduction

The survival of vultures is now at make in the subcontinent. The Indian White-backed vulture (*Gyps bengalensis* Gmelin) and the Egyptian vulture or scavenger vulture (*Neophron percnopterus* Lathan) are the common species, but their populations have registered a sharp decline in many parts of the Indian subcontinent. Diseases compounded by pesticide poisoning and land use changes have affected the species (Islam and Rahmani, 2002; Kler, 2004). Feeding trials were conducted to determine the food requirements of above two species of vultures in laboratory.

## Material and Methods

Experiments were conducted between 1982 to 1983 under "bird menace to air craft project" sponsored by Aeronautics Research and Development Board (ARBD), Ministry of defense, Government of India. An aviary was constructed at the Department of Entomology, IARI., New Delhi. This aviary had individual cages too. Six individuals of each species of vultures were caught with the help of specially constructed and manually operated net, set up before dawn and before the arrival of vultures on carcass at Timapur landfill, Delhi after obtaining permission from the Government authorities. The birds were transported to the aviary at IARI., New Delhi.

Observations on the consumption of fresh meat were made. Six vultures of each species were housed independently in cages of 1.50m X 1.50m X 2.0m size. The birds in each cage were provided with fresh drinking water in plastic pans of 0.45m X 0.60m size and a perching site in the form of horizontal wooden pole of 1.50m length at 0.75m height, weighed quantities of fresh meat of cattle and buffalo were provided to vultures after four days of starvation but with drinking water only. The amount of food consumed by each bird was determined by weighing the left over meat. This experiment was seen for six months, from October 1982 to March 1983. Fresh drinking water was provided to vultures daily. Data were subjected to appropriate statistical analysis.

## Results and Discussion

The average consumption of rate of known quantity of unlimited fresh meat by vultures when offered daily, varied from 100 to 480 gm/day/bird in case of *Gyps* and from 72 to 145gm /day/bird in case of *Neophron* vultures. However, the consumption rate revealed considerable variations among individuals and there were statistical significant differences between the two species in average consumption of fresh meat. *Gyps* species intake was higher than that of *Neophron* species. Singh (2004) too found similar results with respect to *Gyps* species at Vasai, Mumbai. As the time replaced from day one of the experiment, the consumption rate fell, in both the species. The decrease in intake in case of *Gyps* species was more than that of *Neophron* species. This is because in addition to carrion, *Gyps* prefers to feed on offal, garbage, large insects, etc. The *Gyps* vulture prefers to feed on carrion (Ali and Ripley, 1968). The analysis of variance revealed as the time elapsed from day one highly significant differences in food consumption at different times between the two species of vultures. When monthly (average) consumption rates were compared both the species exhibited the decreasing trend. In *Gyps*, from October to March, the rate fell from 360 to 110 gm/day. The corresponding figures for *Neophron* decreased from 128 gm to 74 gm/day/bird. To simulate the natural feeding conditions of vultures, a common feeding experiment on a mixed group of vulture species on fresh and putrefied meat needs to be conducted.

Similarly, food consumption across different carrion feeding vulture's species at different starvation intervals is also required. Singh (2004) conducted research studies at Vasai, Mumbai and Grubh (1974) observed that the quantity of fresh meat consumed by Indian whitebacked vulture in Gir forest of Gujarat was 318 gm. Pennycuick (1969) calculated that griffon *Gyps africanus* could carry a load of up to about 20% of its fat free weight. Similarly, studies of Singh (2004) revealed that White-backed Vulture never ate more than 1000 gm/day, even when starved for period of more than 5 days. Agrawal *et al.* (1983) also arrived at the same conclusion from his studies. These preliminary studies indicated feeding potential of two of our commonest species of vultures.

### **Acknowledgement**

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# Bird Community Characteristics of Selected Cultivated Tracts in Mandya, South Karnataka

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## Introduction

Mandya (12°38' N, 76° 53' E, 716 AMSL) district with 4961 km<sup>2</sup> area (2.59% of the state) is covered by Cauvery river basin in major areas and rest of the (about 45%) area is dry, deciduous land with scrub jungle and hillocks. In irrigated areas, rice, sugarcane and coconut are cultivated in 2.80, 1.14 and 2.2 lakh ha, respectively. Mandya has 7 taluks and 31 hoblies (Honnalingaiah, 2001). A large part of the landscape is covered with river basins, low lying plain land, wooded areas, gardens, scrub jungles, barren red, stony soils and undulating landscapes. In between villages or large tracts of cultivated fields, large patches of tree groves are present, which support a rich avifauna.

Mandya receives on an average annual rainfall of 782 mm with temperatures fluctuating between 15 to 40° C. Adichunchanagiri peacock sanctuary, Melkote temple wildlife sanctuary and Ranganathittu Bird Sanctuary (total = 250 km<sup>2</sup>) are protected areas. Published information on birds of Mandya (Ali and Ripley, 1983) is meager and no information on the role of birds in cultivated ecosystems is available.

## Material and Methods

One hundred and ninety surveys were conducted between May 2001 and August 2004 in irrigated parts of Mandya district. A pairs of binoculars were used to identify and count the birds frequenting the three

cultivated ecosystems. Each time number of birds of each species frequenting the cultivated field, their numbers and activities in the cultivated lands were recorded. Different areas of the cultivated fields were surveyed so as to cover all habitat-patches in each type of cultivated land.

Birds were observed through out the year and at all pheno-phases of the crop the birds were recorded. For each agroecosystem about 50 acers of land area was covered, embracing a number of fields. The status, abundance and species richness were calculated. Appropriate statistical analyses were deployed to arrive at logical conclusions.

## Results and Discussion

### Species richness

In all, from May 2001 to August 2004 190 surveys were made in Mandya district. Seventy six species of birds belonging to 34 families and 58 genera were recorded. Out of these, 28 species were migrants mostly from the Palaearctic region. Migrants stayed only temporarily in the district, showing local movements. Migrants also included the wintering waterfowl. Selected resident birds were recorded throughout the year in the district. Migrants recoded from Mandya were wagtails (*Motacilla* species), flycatchers, sandpipers (*Tringa* spp.), waders, plovers, ducks, teals, redshank, etc. the mean number of bird species recorded each month is given in Table 1 in the three cultivated patches.

Table 1. Number of bird species in each crop each month (Average of 4 years)

| Crop                      | Average number of species<br>Months |   |   |   |   |   |   |   |    |    |    |    |
|---------------------------|-------------------------------------|---|---|---|---|---|---|---|----|----|----|----|
|                           | J                                   | F | M | A | M | J | J | A | S  | O  | N  | D  |
| Rice                      | 4                                   | 5 | 4 | 4 | 5 | 8 | 8 | 9 | 12 | 18 | 20 | 18 |
| Sugarcane                 | 11                                  | 5 | 6 | 4 | 7 | 5 | 9 | 4 | 5  | 7  | 7  | 10 |
| Coconut<br>(26 Years old) | 4                                   | 5 | 4 | 3 | 6 | 4 | 5 | 6 | 5  | 6  | 5  | 6  |

In a month maximum (20) number of bird species were recorded in rice cultivated patches and minimum (3) species of birds were recorded in coconut groves (Table 1). Rice is not cultivated throughout the year in Mandya. Maximum area under rice occurs between July and December. Therefore, in rice ecosystems the number of species showed an increasing trend from July to December. In sugarcane cultivated patches, area of crop canopy increases just before harvest. So maximum (11) numbers of bird species in a month were recorded during December – January. The total no. of species in each agro ecosystem is depicted in Fig. 1.

Graminivorous birds like Munias, Bayas and Sparrows predominated in rice ecosystem. Southern treepie (*Dendrocitta vagabunda*), Small green barbet (*Megalaima viridis*), Pied bushchat (*Saxicola caprata*), Parakeets (*Psittacula* spp.) Doves (*Streptopelia* spp.) and Pigeon (*Columba livia*) frequented all the above three cultivated patches.

### Species Abundance

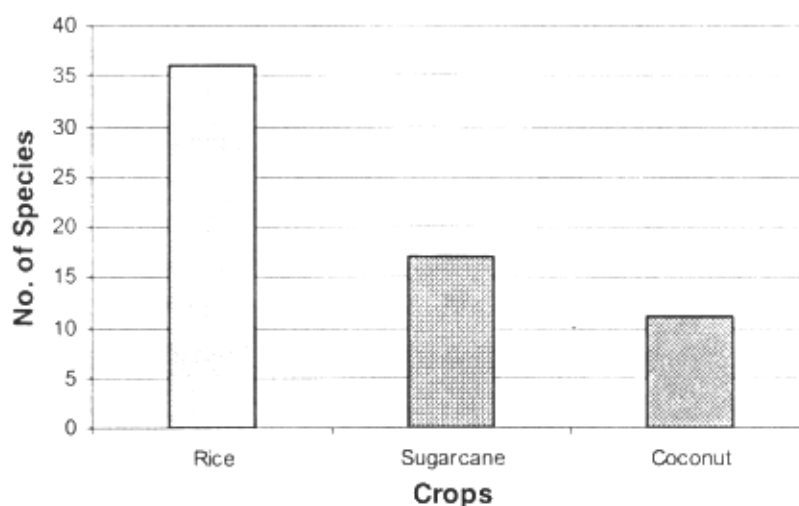
Out of the seventy six species recorded in three agroecosystems, the monthly abundance of each of eight commonly occurring species was counted. Based on the abundance data, birds could be grouped under two categories. The first group of resident birds showed variations in a year. The second category of birds count were almost constant or stable throughout the year. The species under first category were Red-whiskered Bulbul, Small green barbet and grey Jungle fowl, and the second category included Black drongo, Magpie Robin, Red-vented Bulbul, Little Brown Dove and Jungle Babbler.

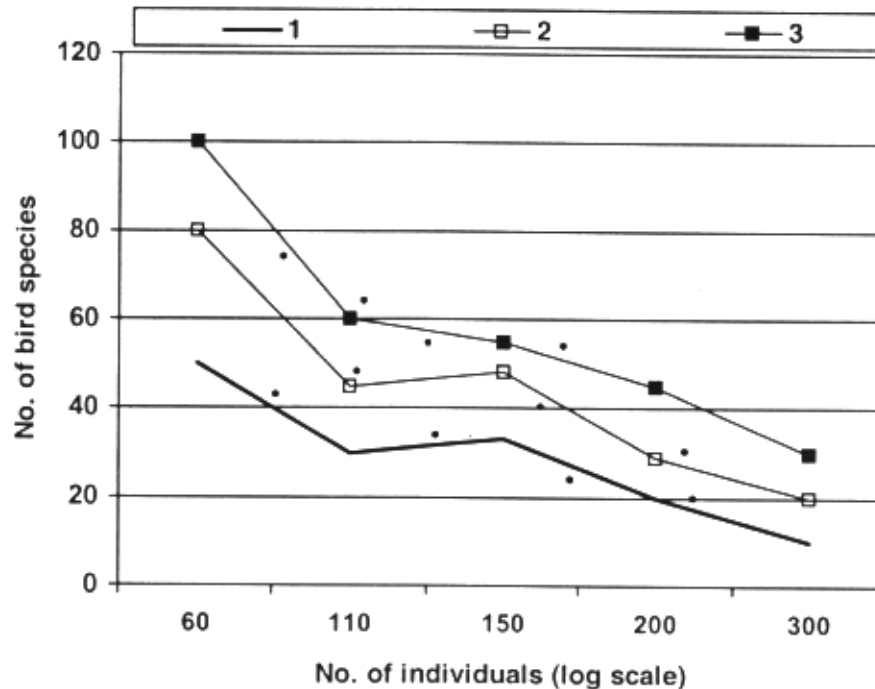
The period of peak bird abundance occurred at different times in each category of agroecosystem. In rice agroecosystem, maximum abundance (28 individuals / 0.5 ac) were recorded during panicle initiation, i.e during September – October. In sugarcane, peak abundance (19 individuals/ 0.5 ac.) was recorded during November when plants were eight months old. In coconut plantation, the number of individuals varied from 6 to 13, showing no clear trend in the occurrence of individuals.

One way of describing diversity in community is through species abundance or distribution models (Fisher *et al.*, 1993). The trends of bird species richness and abundance in three cultivated patches is given in Figure 2, drawn on semi – log scale. This distribution indicates the absence of a single dominant species or group of species. The observed and expected number of species was compared using the Chi-square goodness of fit test. The test showed no significant difference between the observed and expected distribution. This suggest that the distribution pattern followed a log normal distribution in all the three cultivated patches.

In the current study, one factor influencing the species richness and bird abundance was detectability. Seasonal differences in detectability are common for most of the bird species (Emlen, 1971). In agro ecosystem, as the crop grows, the plant complexity increases, decreasing the detectability. Differences in the detectability also result from changes in weather and habitat structure (Jayson and Mathew, 2000). Increasing foliage cover decreased visibility of birds. However, in coconut plantation, since the plant

**Fig.1 Total No. of Bird Species in Different Agroecosystems**





**Fig. 2. Distribution of species richness and abundance in three cultivated patches**

biomass did not change much overtime, these factors did not play a role in the species richness and abundance of birds. Rainfall may have also affected visibility or detectability of birds.

The abundances of birds indicated the capacity of different agroecosystems to hold different kinds and densities of birds. Densities of birds depend on resource availability and area of agro ecosystem. It also depends on whether the species is resident, locally migratory or migratory. Birds perform different roles as grainivores, insectivores, scavengers or pollinators. So agroecosystem can function as buffer zones for birds. Traditionally farmers do not take pesticides applications in the above three crops. But with upsurge of new pests in 'out break' form, has forced farmers to take up insecticide applications, there by reducing bird diversity and their beneficial roles in agro ecosystems.

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# Tsunami, Mangroves and Wetlands: An appraisal

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## Introduction

Water waves that followed the December 26, 2004 earthquake off the Sumatra coast, crashed into coastlines all around the Bay of Bengal. Nearly 2.5 lakh people died, millions rendered homeless and lost sources of sustenance and livelihood. What can we learn from such a disaster? What are the recommendations for immediate actions? What are the long term plans? What do the rapid assessments pinpoint? This compilation sums up the emerging issues and provides a window for thinking on the approaches to some of these issues in the aftermath of tsunami.

## Early indicators

Reports from the Yala national park in Srilanka have indicated that animals in the park deserted the place before tsunami and almost no casualties were reported amongst them. Similar observations were reported from the Point Calimere wild life sanctuary, Tamilnadu. Ten minutes before the tsunami crashed into the sanctuary, all animals (*viz.*, blackbucks, spotted deers, feral horses, wild boars and jackals) rushed towards higher grounds. Birds like Flamingos and other migratory waterfowl were also seen flying away before the water waves came. The birds returned about an hour later and were seen feeding, as if nothing had happened (Srinivas, 2005). The marine turtles too seem to have come out of water from the giant ocean waves of December 26, 2004 (Protected Area Update, 2004). While it might be difficult to conclusively prove or explain what these responses were, or how they came about, an effort should be certainly made to see if the high-tech early warning systems could be complimented with systematic observations of animal behavior to get some early signals. It seems all wild denizens of this planet are still one up on their human counterparts (Protected Area Update, 2004). Mr. Ravi Corea, president, Srilanka wildlife conservation society, sighted elephants running away and bats frantically flying just before the tsunami struck. According to Alan Rabinowitz, animals can sense impending danger by detecting subtle or abrupt shifts in the environment. Along India's Cuddalore coast where thousands of people perished, buffaloes, goats and dogs were found unharmed.

## Folklore Knowledge and wisdom

Our forefathers had noticed the behaviour of birds and other animals from time to time and had developed faith in weather prophecy and perfected some sort of home-made weather predictions. Some ancient weather predictions are recounted here.

Aristophanes had said of the Greeks :

*"From bird in sailing men instruction take  
Now lie in port, now sail, and profit make"*

A nature lover at the Gardiner's Island, at the eastern and Long Island, New York, where fish-hawks then abounded, had told Alexander Wilson, many interesting facts respecting habits:

*"The fish-hawks are sometimes seen high in the air, .. On these occasions they serve as a barometer to foretell the changes of the atmosphere; for when the fish-hawks are thus sailing high in the air, in circles, it is universally believed to prognosticate a change of weather, often a thunderstorm in a few hours. On the faith of the certainty of these signs the experienced coaster wisely prepares for the expected storm, and is rarely mistaken".*

It would be hard to narrate a better epitome of the "Signs" given by birds to the weather-prophet. Some sailors used to sing a popular rhyme -

*"When men-of-war-hawks fly high, It is a sign of clear sky;  
When thy fly low prepare for the blow"*

*"Everything is lovely and the goose honks (not 'hangs') high"*

*When the swallow buildeth low  
You can safely reap and sow"*

Naturalist Hudson wrote about the musical martin (Progne), familiar about Buenos Ayres: *It is... naturalist's barometer, as whenever, the atmosphere being clear and dry, the progne perches on the weathercock or lightning-rod, on the highest points of the housetop, or on the topmost twig of some lofty tree, chanting its incantation, cloudy weather and rain will surely follow within twenty-four hours"*

Dozens of proverbs mention as indications various unusual actions noticeable in poultry, such as crowing

at odd times, clappings of the wings, rolling in the dust, standing about in a distraught kind of way, a tendency to flocking, and so forth.

*"When the peacock loudly bawls  
Soon we'll have both rain and squalls"*

A twenty five century old Roman saying:

*"If the November goose-bone be thick,  
So will the winter weather be  
If the November goose-bone be thin  
So will the winter weather be"*

Almost every country has a rainbird whose cry is supposed to foretell showers.

*Cuckoo oats and wood cock hay  
Make a farmer run away*

"If the spring is so backward that the oats cannot be sown until the cuckoo is heard, or the autumn so wet that the hay cannot be gathered in until the woodcocks come over, the farmer is sure to suffer great loss"

### **Impact of the tsunami**

Major impact includes massive loss of human life, destruction of coastal settlements, infrastructure, loss of fishing boats and facilities, loss and degradation of agriculture lands, forests, mangroves, nesting colonies of birds, and contamination of fresh water sources.

According to rapid assessments, the main impacts of the tsunami on coastal wetlands varied according to location and distance from the epicenter or fault line. Impacts include:

- ❖ Loss or degradation of mangroves and sea grass beds
- ❖ Silting and degradation of coral reefs
- ❖ Sedimentation or turbidity of coastal waters leading to algal blooms, and
- ❖ Major changes in inter-tidal flats and coastal lagoons.

Certain wetland types played a role in reducing the tsunami impact, especially in locations further from the epicenter, coral reefs and mangroves broke the impact of waves and absorbed some of the energy and protected areas further inland. Mangroves also prevented people from being washed out to sea and also trapped debris, reducing further damage.

The response to the tsunami by the affected countries in relation to coastal wetlands was mainly on rescue efforts of local communities followed by rapid assessment of impacts.

Although the tsunami tragedy affected the rich and the poor alike, the economically and socially challenged sections of the society are least likely to benefit from macro-reconstruction plans. They will be unable to recover their basic rights of access to and the use of natural resources. Well intentioned government plans may be slow to respond to the needs of marginalised farmers and fishermen. Traditional farmland may now be saline and infertile and some farmers may even lose tenure of their land under revised land-use allocations. Fishermen may be resettled too far from the sea and associated workers; the fish-driers, packers and transporters, the ice-providers and boat repairers, net repairers – may not be eligible for compensation. Thousands of small family enterprises, with a lineage of dependents may be deprived of their livelihoods.

Access to fresh water – both for personal use and irrigation – has been disrupted and the ecosystems of the inland fresh water coastal lagoons that characterize the west-coast of Srilanka, have become impaired. Sluice gates, drains and dykes that enabled even subsistence fishers and farmers to control coastal plain rice field and shrimp and fish ponds have been damaged or swept away. However, coastal wetlands provide so much more than fish and shrimps for Asian people: Seaweed, sponges, sea-cucumbers, sea-anemones, sea-quirks, sea slugs, jelly fish, crabs and a huge range of molluscs and other organisms are traditionally used as food and medicines. Fresh water wetlands behind the coast often provided the only source of water for washing, cooking and bathing. The tsunami has left gender and age imbalances in the population and redevelopment plans need to ensure that needs of womenfolk are properly addressed; these should include developing livelihood options for widows of fisherman and other breadwinners.

Marine turtle conservation programmes in the Indian Ocean have suffered considerable damage from the giant ocean waves of December 26, 2004, severely undermining regional plans to save this highly endangered marine reptile. The Indian Ocean and South East Asian Marine Turtle Memorandum of Understanding (IOSEA MoU) has started assessing the extent of damage caused. Turtle conservation facilities in the Indian Nicobar Islands, Srilanka and Thailand were the hardest hit with reports of dead and missing field staff and destruction of research stations. The Andaman and Nicobar environment trust field-station at Campbell Bay in great Nicobar was devastated. But the Gahirmatha Marine Sanctuary in Orissa escaped virtually unscathed. Waves surged

into the Babubali and Agarnasi nesting grounds, causing minor erosion on the sandy beach. Several privately owned turtle hatcheries were also affected by the killer waves which shattered the holding tanks and washed away the reptiles therein.

### **Tourism affected**

The tsunami couldn't have come at a worse time for Asian tourism. In 2004, global tourism boomed in line with economic recovery. In Asia, recovering from SARS-induced slump in 2003, the growth was unprecedented. Though Europe still remains far ahead, Asia was catching up. Data for 2004 shows Asia pacific registered a 37% rise in tourist arrivals. North America reversed the negative growth of three successive years with a growth of 12%. Europe's growth of 6% though above average, is much lower than Asia. India hit the 3 million mark for the first time in 2004, while tourism to west Asia grew by 24%. Now, in the aftermath of the tsunami, how much that picture will change is anybody's guess. The data from WTO available till 2003 shows France continued to maintain the top slot, with 75 million international arrivals in that year. Overall, international tourist flows increased by about 27% from 55 million in 1995 to 70 million in 2002. But the direction of tourist flows has changed significantly. Asia was the biggest gainer its share in tourist arrival increasing from 15.55 % in 1995 to 18.7% in 2002.

### **Role of mangroves**

Much of the damage could have been contained on that fateful day, if the natural Mangrovephyte and Psammophyte (sand plants) communities had been left intact along the coastlines, deltas, estuaries, backwaters, bay islands and lagoons. Reports have suggested that some areas of mangroves not only survived the tsunami onslaught very well, but also offered significant protection to coastal areas. According to Mike Crosby, Research and Data Manager, Birdlife International, Asia Division (in World Birdwatch, Vol. 27 No 1, March 2005, visit [www.birdlife.org](http://www.birdlife.org) for details), the town of Krabi in southern Thailand was in all probability spared from colossal destruction because of the adjoining mangrove forests.

The first global environmental assessment published by UNEP has concluded that healthy coastal ecosystems, such as coral reefs, mangroves, other coastal vegetation and intact sand dune systems have the ability to protect people and property. Mangroves function as a natural hedge or barrier in reducing coastal erosion; suppress storm surges, cyclonic floods and

wind velocities. The presence of mangroves with the stilt root system, along the river banks and estuarine mouth, functions as a tide breaker that prevents high speed saline tides and waves and protects adjacent inland vegetation. For this reason, the December 26<sup>th</sup> tragedy is all the more compelling us, to conserve and restore the decimated mangrovephyte and psammophyte communities.

The loss of mangrove community has affected the lives of many birds and other related organisms in the marine-food chain. The slide began with the removal of crowns from the mangroves for fodder and other household purposes. The thick foliage and crowns are crucial for mangrove-dependent species such as sandpipers, storks, herons, egrets, bitterns, godwits, curlews, plovers, oystercatchers, terns, gulls and snipes. They not only take refuge and roost amid the foliage but also build nests. They enrich the mangrove habitats with their nitrogen-rich droppings.

India has 6740 sq. km of littoral regions including deltas, estuaries, backwaters, bay islands and lagoons; collectively classified as mangals (Mangrovephytes), which is the third largest in the world after Indonesia (25000 sq.kms) and Australia (11620 sq. km). But a significant portion of the mangrovephyte habitat is degraded or lost and the remaining portion is said to be tethering on the brink of eradication. Kerala had around 700 sq. km of Mangrove forests. Today it is reduced to a mere 17 sq. km.

The uses and values of mangroves and the mangrove ecosystem are many. *Nypa fruticans* is a potential alcohol yielding palm; which has good prospects as an alternative automobile fuel. The *Rizophoraceae* members produce tannins, adhesives and special glues. It is apparent that Sundarbans is named after the Sundari tree (*Heritiera sps*). This mangrove species has good fiber yielding properties currently in use as flooring and paneling material. Decoction from the fruits of *Xylocarpus* reportedly has breast cancer curative properties. *Exoecaria* and *Sonneratia* are soft wooded and are used as alternate to wood pulp in the paper industry. *Nypa fruticans* produces sugar, alcohol, vinegar, fermented drinks and its leaves are traditionally used as thatching material and due to its waxy coating, it lasts a decade or more. Decoction from the bark is used in the treatment of diarrhoea, dysentery, to stop bleeding, and to cure leprosy. Bark and sap from *Cerbera* are purgative in nature and the oil extracted from its fruits is used in the treatment of rheumatism. *Pneumatophores* of *Bruguiera* produce aromatic substance. *Avicennia* is a good fodder for cattle, and is said to increase milk yield. *Sonneratia* fruits are



eaten by deer. Fruits of *Avicennia* and *Sonneratia* are good fish food. Marine fish, crustaceans, shellfish, amphibians, birds and mammals are dependent on the mangrove ecosystem.

Mangroves have the capacity to trap debris, and protect rich organic soil washed down through river system to the sea and redouble as rich nursery grounds for many marine fish, invertebrates, mollusks, birds, reptiles and mammals. Mangroves also regulate rich organic-laden water flow, stabilize the alluvial soils brought in from the rivers, and fix the sediments of the sea with detritus. Thus they are the richest productive ecosystem for sustaining marine and estuarine biodiversity. Bacterio-fungal decomposers thrive and convert mangrove litters into consumable protein which is used by fish population and they ultimately end up with the primary consumers in the food chain such as tigers and crocodiles.

### **Shorebirds benefit from Mangroves**

The National Mangrove Committee is yet to successfully develop a model for the management of mangrove forest ecosystem that can be showcased as India's preparedness to deal with the socioeconomic problem and the tsunami threat alike. The shorebirds will be the incidental beneficiaries of such afforestation programmes and they can gradually regain their long-lost foothold on the mangrove habitats (Sridhar, 2005).

### **Recommendations for actions**

- ❖ There is an urgent need for coordinated and harmonized assessments in priority stretches of affected coastline in order to identify areas where ecological restoration would be most effective.
- ❖ Develop predictive guidelines on the value and appropriate positioning, structure and composition of natural green-belts and mangroves to provide protection to coastal communities from severe storms/tsunamis.
- ❖ Integrated wetland restoration and management options with immediate response to humanitarian need coupled with short and medium term action plans and recovery plans in tsunami affected countries, should be developed.
- ❖ Develop community led approaches for protection and restoration of affected wetlands, drawn from traditional knowledge and practices and announce incentives for sustainable livelihood development plans. Encourage local communities to be on the lookout for certain peculiar behaviour of birds, reptiles and other organisms, which may indicate

or forewarn, impending disasters like tsunamis and cyclones.

- ❖ Establish and enforce "no construction zones" in vulnerable areas and manage them to enable sustainable use by local communities, as well as ecosystem recovery.
- ❖ Build and strengthen regional / international cooperation mechanisms to connect government, agencies, institutions, communities and individuals. Combine their competencies in assessment and in developing and implementing action plans, related to the tsunami response and coastal wetlands.
- ❖ The functions of the partnership would be the following:
  - Provide access to information
  - Furnish technical knowledge, expertise, guidelines and tools
  - Support capacity building; and
  - Strengthen partnership, coordination arrangement and access to financial resources.

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# A Brief About the Bird Flu

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## ***What is bird flu?***

In 1997 a certain strain of flu affected thousands of chicken and six persons in Hong Kong. When it was discovered that the virus was the deadly H5N1 type, some 1.5 million chicken were destroyed to stop its outbreak. Later, the virus was detected in Cambodia, China, Malaysia, Vietnam, Indonesia and Laos.

Flu or Influenza – is a contagious respiratory viral infection, which is airborne and transmits like cold virus, and is sub-classified as A and B Viruses. Virus A infects ducks, chicken, pigs and whales. In humans, it is more dangerous because the two proteins Hemagglutinin (HA), Neuraminidase (NA) are protein bound and accordingly sub divided into 16 and 9 subtypes in HA & NA. Thus, there are chances of some 144 combinations of the deadly virus flu originating from these subtypes. Flu attacks are common in winter and they gradually change by mutation almost every year and people usually develop immunity for it. But, often they become virulent when there is a new virus. Such a phenomenon is referred to as antigenic shift. During this stage no one can develop immunity and this could not only be dangerous but also deadly. Virus B infects human beings. Human Flu affects every year between 5 and 15 % of the world's population. Mostly, elderly and debilitated people die of flu and the fatalities could be anywhere between 2.5 and 5 lakhs, every year. But for the healthier people, it is just another winter Flu and they would have developed some immunity before hand. Epidemic is an outbreak of a disease affecting a lot of people and pandemic is a disease affecting populations across the globe. In 1918, 1957 and 1968 pandemic like flu was noticed and the worst scenario was in 1918 when the flu took the lives of some 15 million people.

In the case of Bird flu, we have little information about how people get affected. It is suspected that the virus is transmitted through chicken and duck faeces. After drying up, the bird faecal matter becomes powdery, which in turn can contaminate hands and mouth. It is also possible for the fine powder to enter the lungs through inhalation. However in September – 2004 in Thailand, a mother contracted the flu through her eleven year old daughter and died. No other person was infected even though the flu was highly

contagious. Thus the H5N1 Flu does not seem to be so much contagious between bird and man, and from one man to another.

## ***“Now what is the danger?”***

Let's assume that I am infected by human Flu H3N2, which is affecting human beings since the last three years. I develop Flu symptoms of cold, cough, fever and feel very sick. When my immunity is fighting H3N2, a new virus *i.e.* the H5N1 Bird Flu virus attacks me. Now there could be exchange of genes resulting in a mutation and a hybrid strain of the Avian Flu can originate. This deadly hybrid virus might get transmitted easily like human virus on a global scale, which could be difficult to curtail.

Since 1955, there have been nearly two dozen outbreaks of highly pathogenic Flu in Birds. But this year unlike the earlier years, we have a bird Flu in 9 countries. Some 150 million birds died or were killed (culled) as per a W.H.O. bulletin. H5N1 has become more lethal for mammals. Some birds may be mere carriers, transmitting the disease all along their migratory paths.

In April 2005 outbreak of Bird Flu in Quing Hai lake in west China, was reported in one Island but by 20<sup>th</sup> May the disease had spread to most of the islands in the region killing thousands of birds.

## ***“What can be done?”***

Vaccines for pandemic Flu are available. The procedure for developing this vaccine is complicated, as it involves utilization of a fertilized hen's egg, necessitating elaborate trials and tests before commercial production. Presently some 300 Million doses are available, which is enough for 5 % of the world's population. Usually it is administered intradermally. Assuming that the quantity of dosage is reduced to 25%, on account of the shortage of the vaccine, it may suffice 20% of the world's population. Even this reduced dosage may trigger the production of antibodies.

We also have antiviral drugs like Tamiflu, approved by WHO, which can reduce the severity and duration of this viral disease (Zanamivir and Oseltamivir) by 80% and effective in reducing febrile Flu.

### ***“Is there a need to panic?”***

As of July 2005 it has not been highly contagious to humans. H5N1 Like all Flu is a respiratory virus transmitted by air. Out of 109 human cases reported 55 died.

Only one case of human to human transmission was noted in Thailand in 2004. If there is no mutation of the H5N1 virus there is no need to panic. But, if it mutates, it is difficult to predict the severity of repercussions. But medical science has advanced to combat with modern techniques and tests.

### ***“What about India’s Preparedness?”***

Migratory birds have already arrived in India. Government of India has taken precautionary measures to prohibit import of poultry and their products. Constant surveillance of poultry farms and poultry laborers is called for. Early warning and plans to strengthen the warning systems are crucial. Tamil flu has to be stockpiled in adequate quantities. CIPLA is licensed to manufacture Tamil Flu. The Ministry of Health claims that it has 10 Lakh doses in stock and is negotiating with Roche and Glaxo Smith Kline for adequate supplies of the vaccine, which may be shipped to India by March 2006. Apart from these measures new tri-valiant live attenuated influenza virus vaccine is under going trials. The Ribovarin is supposed to be effective in both type A and B Flu.

### ***Bird Flu Related News Items***

#### **Red alert at Kaziranga**

Manipur has reported the spotting of a red legged crane. This has alerted the northeastern states to

take precautionary measures because it is the home to migratory birds from China & Europe. Especially Kaziranga National Park in Assam nurtures a host of migratory and resident birds. Hence the authorities have alerted the public to observe and report any abnormal behaviour of birds. This is only a measure to protect the migratory birds as well as the birds under endangered list. A veterinary avian flu specialist has been advised to keep vigilance at birds both in wild and livestock.

### **Spinning out of Control ?**

Time Global Health Summit, a three day event in New York is discussing key health issues. According to W.H.O.'s statistics avian flu has killed at least 62 people including 41 in Vietnam and has taken the lives of more than 100 million chicken in Asia since 2003. UN Secretary General Kofi Annan warns that the avian flu could “Spin out of control” claiming millions of lives if the virus acquires the ability of human to human transmission. If this calamity sets in it is just a matter of weeks to lock down the spread before it spins out of control. He has advised the International community to take up an immediate action.

The Asian Development Bank (ADB) reports that the global avian flu pandemic could kill million people in Asia and plunge the world into recession. If such a outbreak occurs the growth in Asia would virtually stop due to the economic impact as it would affect the gross domestic product in consumption, trade and investment. It may also have an impact on the working conditions and mortality.

# Bird Flu : An Update

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## **Introduction**

The spread of bird flu looms large over the Indian subcontinent. While much of East Asia has grappled with the disease, Europe and Russia are just beginning to react. With 60 people dead in Asia and an outbreak threatening Greece, Turkey, Romania, Germany, China, and Canada, how prepared are we in India? This compilation summarizes the information on bird flu available on the web and the media. This compilation is meant to create an awareness and to amplify the preparedness of birdwatchers, Ornithologists and the public for any eventuality. This document also exhorts all to be vigilant, extra cautious, to coordinate and to monitor the spread of the bird flu. This compilation is also intended to be used as a ready reference material by all those involved in the prevention and controlling the spread of this disease.

## **History**

The outbreaks of bird flu began in Southeast Asia in 2003. Since then, this bird flu has led to death or slaughter of some 140 million domestic birds, resulting in losses to Asian poultry industry estimated at around \$10 billion. Worse, the virus has shown that it is capable of infecting humans and claimed the lives of 60 people. The Asian flu of 1957-58 and Hongkong flu of 1968-69, each killed more than 1 million people. Spanish flu of 1918 and 1919, killed upto 40 million persons and sickened, at an estimated 20-40% of the world population. Two of the last three global pandemics, all in the 20<sup>th</sup> century originated in Asia. Earlier the outbreaks were restricted to Indonesia, Vietnam, Thailand, Laos, Cambodia and China. In May and July 2005 many thousand wild waterbirds were found to have died at Qinghai lake in western china and the H5 N1 virus was isolated from the dead birds. In late July, outbreaks of the virus in poultry and wild birds were reported from Siberia, Russia and neighboring Kazakhstan. In early August, in Mongolia many migratory birds at two lakes died after being infected by the lethal strain of virus. Recently, outbreaks of this bird flu have been confirmed in Turkey and Romania. In both countries, thousands of domestic birds have been destroyed. On October 22<sup>nd</sup>, 2005 bird flu was detected in a parrot in UK and among swans in Croatia

## **What is the virus?**

Bird flu is an infection caused by avian (bird) influenza (Flu) virus called H5N1 virus. It is the subtype of Virus A which infects birds, primarily. Normally, waterfowl notably the ducks, carry the virus, but do not suffer from the disease. It occurs naturally among birds and it's very contagious. It generally kills chickens, ducks and turkeys. It was first isolated in birds of South Africa during 1961. It spreads very rapidly among birds, destroys internal organs and has a mortality that can reach 100% within 48 hrs.

## **What are the symptoms?**

Fever, cough, sore throat, muscle aches, eye infections, pneumonia and severe respiratory diseases such as acute respiratory distress in humans. Affected birds show swelling of the head, nasal discharge, fever, diarrhoea, etc.

## **How does the disease spread?**

Migratory waterfowl, especially ducks, carry the viruses. Although they often appear healthy, these infected birds shed viruses in their droppings, saliva and nasal secretions. Domestic poultry, especially chickens, turkeys and geese, become infected from contact through contaminated water, feed or soil, or even by inhaling the air borne virus. Humans contract the bird flu virus from close contact with sick birds or with surface contaminated by their feathers, saliva or droppings. Although this virus did not infect humans, several instances of human infections have been reported since 1997.

Although migrating wild birds are the prime suspects in this spread of bird flu, the extent of their involvement is uncertain. The evidence implicating the wild birds is circumstantial. A "smoking gun" in the form of migratory birds infected with H5N1 shedding the virus in the droppings and secretions and healthy enough to fly long distance has still not been found. Lack of such evidence, however, does not rule out the possibility that some species of migratory birds are capable of harboring the virus and remaining healthy. After visiting Russia, an expert team from the world organization for human health (OIE) recently concluded that "In certain conditions migratory birds

could carry the Asian H5N1 influenza virus to other parts of the world".

In the absence of specific information about which species of migratory birds might be capable of acting as carriers of the virus, countries in Europe, the Middle East, South Asia and even South East Asia that are currently free of the bird flu are making frenzied preparations in case wild birds bring the virus to their shores. If migrating wild birds are indeed carrying H5N1 virus, there would be a risk of the virus being passed on to poultry flocks. Wild birds infected by bird flu shed vast quantities of the virus in their droppings and secretions. So poultry flocks can become infected with these viruses in a number of ways, including:

- \* Poultry being free to mix with wild birds.
- \* Wild birds may defecate while flying and their droppings can fall in open fields where there are poultry.
- \* Water that poultry drink comes from a source like, a lake that is contaminated by droppings from infected wild birds.
- \* Food that the poultry eat can be contaminated with droppings from infected wild birds.
- \* Humans, vehicles and objects such as, farm implements can become contaminated through contact with droppings from infected wild birds and carry the virus to poultry.

### ***Disease is spreading***

"We have not reached the level of (Vaccination) preparedness that we should have", Mr. Kyprianou told reporters after updating the foreign ministers on the west ward spreading of bird flu. The WHO has said though the arrival of the virus in a new location is worrying – because more virus means more opportunities for genetic mutations – it does not mean a human flu pandemic is closer. Isolated outbreaks that are swiftly controlled pose a minor threat compared with prolonged outbreaks where, birds continue to mix with people, as in Asia. The European Union health ministers, meeting on Thursday and Friday outside London, will discuss national flu preparedness programmes, including the availability of antiviral drugs across Western Europe. The H5N1 bird flu strain has swept the poultry populations in large swathes of Asia since 2003, jumping to humans and killing atleast 61 persons - and more than 40 of them in Vietnam and resulting in the deaths of tens of millions of birds.

### ***Role of migratory birds***

"No case of Avian flu has been detected in the Indian poultry industry so far. There is no reason to panic", says Sandeep Mehta, echoing the views of others in the trade and back yard breeders. But the threat is very real considering India is on the itinerary of migratory birds attracted to reservoirs, lakes of dams in north, Mumbai's creeks, salts pans of Kutchs and artificial ponds of south India.

The season is ripe for their arrival. Infact, the first international winged visitors have already arrived at Pong dam in Himachal Pradesh which is playing host to gulls, bar headed geese and cormorants among others. Then there will be waders like redshanks, curlews and brown headed gulls that will descend on Indian shores later this month or early November. In the marsh lands, birdwatchers will be roped into "watch out for signs of illhealth" among the visiting flocks" Around 2000 bird lovers, who are the members of Indian bird conservation network which is an association of 80 NGOs, will fan out to 173 bird areas across the country for this task. "They will have to look for sick birds, especially to those that seems unable to fly". said Zaffer of the Bombay Natural History Society coordinating the effort.

BNHS has been part of several meetings called at the centre to discuss ways to tackle likely pandemic of the Avian flu. The meeting will decide whether the watchers should hand over the birds to central laboratories that will be testing for the virus or only alert government officials. The virus being contagious there is a need to handle such birds with care. Monitoring teams are at Haigam and Hokersar in Kashmir, Pong dam in Himachal, Harike in Punjab, Keoladeo National Park in Rajasthan, Kahar Lake in Bihar and Chilika lake in Orissa. Across the world 117 cases of bird flu have been reported with 60 fatalities. According to the latest report the infection has spread to birds in European countries such as Turkey, Romania and Greece.

According to Dr. H.K. Pradhan, HSADL, Bhopal, in India Bar-headed Geese, Large cormorants and Black-headed Gulls are the species the centre has asked State Government to lookout for as suspected carriers. The good news is that highly pathogenic avian influenza virus has not been detected in 17,000 serum and tissue samples collected from across the country. According to BNHS, faecal samples of birds will be useful but will not tell which bird is infected.

### **Migratory birds affected (found dead)**

Bar-headed Goose, *Anser indicus*

Pallas's (Great Black-headed) Gull,  
*Larus ichthyaetus*

Brown-headed Gull, *Larus brunnicephalus*

Ruddy Shelduck, *Tadorna ferruginea*

Great Cormorant, *Phalacrocorax carbo*

Total number of wild birds found dead as on 21<sup>st</sup> May 2005 was 519 of which 178 were reported to be Bar-headed Geese (which had just completed their migration from the wintering grounds). By 4<sup>th</sup> May, bird mortality was more than 100 a day; by 20<sup>th</sup> May, the outbreak had claimed some 1,500 birds. Since then, official reports indicate that more than 6,000 birds had succumbed to the disease by the 1<sup>st</sup> July and far more may have been affected. Incidentally, the number of birds killed by the disease dropped to about 20 a day since 8 June, 2005.

Researchers say evidence of the H5N1 pathogen was found in the affected birds. There is also evidence that this H5N1 viral strain is now being transmitted between wild birds. Previously, the flu was only seen to move to wild birds from domestic fowl. The occurrence of highly pathogenic H5N1 AIV infection in migrant waterfowl indicates that, this virus has the potential to be a global threat. Evidence of spread in wild geese means farmers outside of Southeast Asia should now be more vigilant for signs of the disease. Avian flu is almost impossible to stamp out once it becomes established in farm poultry populations.

In mid August, the survivors will start returning to their winter ranges, which stretch from Eastern Europe to Australia and Alaska, and overlap with the ranges of other migrants. If some birds carrying the virus remain healthy enough to migrate, the disease could spread far and wide. There are 3 major migrating routes for birds in China. The recent outbreak appeared in the western route, from south and central Asian countries to the northern part of the Indian Peninsula, then over Tibet and Himalayas to Qinghai province.

The large bird population at Qinghai Lake make it unlikely that the outbreak would burn itself out and there is real fear that returning migrants could act as carriers and spread the virus along major migratory flyways while remaining highly pathogenic for domestic poultry. It is not known yet whether infected birds can last the arduous journey over the Himalaya to reach India though some experts believe that unfit birds will not be able to take the stress of migration.

While all the other four affected species (Brown-headed Gull, Pallas's Gull, Ruddy Shelduck and Great Cormorant) winter in India, there is no evidence that these birds travel to India from Qinghai province. It is very likely that these species do not travel such long distances to over winter here.

The Departments of Environment and Forests, and Animal Husbandry, Government of India will monitor 50 bird sanctuaries in the country for signs of bird flu virus in 2005-2006. The birds that will be closely watched are Bar-headed Geese, Brown-headed and Pallas's Gulls and Great Cormorants.

All State Animal Husbandry Departments will take blood samples from poultries in the vicinity of bird sanctuaries and, where possible, from migratory birds.

Sanctuary-wise monitoring will be done continuously and samples will be sent to the high-security Animal Disease Laboratory in Bhopal.

### **Status of vaccine and drugs**

No vaccine is available, because no one knows the precise shape that the virus will take after mutating to the feared highly contagious form. The race is on in India, USA, Germany, Hungary and Vietnam. Several prototypes are being explored, but the risk is that they could be only partially effective. If a pandemic does occur, one worry is about manufacturing capacity and distribution ; making enough of the vaccine and getting it on time and to the right people, without causing panic or black market or leaving poor countries helpless.

Two drugs, Oseltamivir (commonly known as Tamiflu) and Zanamivir (commonly known as Relenza) can reduce the severity and duration of illness caused by seasonal influenza. Their efficacy depends on their administration within 48 hr. after symptom onset. However, fears are that the flu virus may soon become resistant to it. Tamiflu is also expensive and in limited supply and thus would not be effective in the face of a wide spread epidemic.

A case has been reported in which the virus in a Vietnamese teenager has proved resistant to the drug Tamiflu. This has heightened concern about the Roche holding the drug, currently the centerpiece of global and national drug stockpiles against a possible pandemic of H5N1 Avian influenza. The girl did not have direct contact with sick poultry birds but cared for her brother while he was ill with avian flu. The viruses could have transmitted from brother to sister.



### ***Policy Statements and Recommendations of Key Global Organizations***

An outburst of avian flu in migratory birds in China, Russia, Romania, Germany and Ukraine has raised fears that the virus responsible could soon spread to India and other countries.

A highly pathogenic A/H5N1 strain of Avian influenza is endemic in Southeast Asia affecting eleven countries in the area. Countless and innumerable chickens have been culled, but there is an inexhaustible reservoir. H5N1 is highly contagious and lethal in chickens, but it can be carried without symptoms in some ducks — a combination that helps keep the flu in circulation. The virus has thus far affected more than 100 people and has claimed at least 55 human lives in Vietnam, Thailand, Cambodia and Indonesia.

WHO and influenza experts worldwide are concerned that the recent appearance and widespread distribution the avian influenza virus, Influenza A/H5N1, has the potential to explode as a pandemic which could endanger millions of people worldwide if it acquires the ability to pass easily from human to human. What is certain is that, if the virus spreads to other countries, it will decimate poultry industries, which is already in doldrums.

Fortunately, India has not reported any case of "Avian influenza" or "Bird flu" till date.. However we must anticipate its arrival and spread in India in the near future and be prepared to act in response, if we are to contain the disease lest it gets out of control.

#### ***BirdLife International: Statement on Bird 'flu'***

The H5N1 virus seems to be spreading, with recent outbreaks in China, Kazakhstan, Mongolia, regions of Russia and countries around the Black Sea, on top of the spread through Asia since the end of 2003. It is not yet entirely clear how the disease is spreading, but clearly there is a possibility that migrating waterbirds may be involved.

There are numerous strains (at least 144) of Avian influenza, many of which circulate in wild birds at low levels, but which can occur more frequently in waterbirds. Most of these viruses within wild bird populations are benign. Highly pathogenic-avian influenza viruses can cause great mortality in domestic poultry flocks but are very rare in wild birds. H5N1 is highly pathogenic but was never recorded in wild birds before the recent outbreaks in South Eastern Asia, Russia and countries around the Black

Sea. It is likely that it originated in domestic poultry through mutation of low pathogenic sub-types and was subsequently passed from poultry to wild birds.

Transmission is promoted in domestic flocks due to the density of birds and the consequent close contact with faecal and other secretions through which the virus can be transmitted. Husbandry methods in South Eastern Asia where domestic flocks are often allowed to mix freely with wild birds, especially waterfowl will have facilitated the transmission to migratory waterbirds, leading to several reported instances of die offs.

There is no evidence that H5N1 infection in humans have been acquired from wild birds. Human infections have occurred in people who have been closely associated with poultry. The risk to human health from wild birds is extremely low and can be minimised by avoiding contact with sick or dead birds. However, there is a possibility that this virus could develop into one that might be transmitted from human to human. If this happens, then it is most likely to happen in South Eastern Asia, from where it could then spread rapidly around the world.

The situation is evolving rapidly from day to day, and our position on the disease and proposed control measures will continue to evolve as new data emerge. The points below are based on the best information available on 14 October 2005

1. The most recent outbreaks suggest that migratory birds may have transmitted the disease between countries or regions. Although this link has not been proven we cannot ignore the possibility. Movements of domestic poultry, another possible transmission route, have been largely implicated in the spread of the disease in South Eastern Asia.
2. There have been no recorded instances of transmission of the disease between infected wild birds and humans. The H5N1 virus strain is not currently contagious between humans and most human cases to date have been associated with close contact with infected domestic poultry. The risk of a human contracting the disease from a wild bird is remote, unless there was excessive close contact with infected birds and their excreta.
3. Killing of wild birds are highly unlikely to stop the spread of the disease and are extremely difficult to implement. This view is shared by the World Health Organization, Food and Agriculture Organization of the United Nations, the World Organisation for Animal Health and the UK

Government. Indeed, culls have the potential to make the situation worse by dispersing infected individuals and stressing healthy birds, making them more prone to disease. Moreover, it would divert resources away from important disease control measures.

4. The most efficient control techniques involve improved biosecurity, primarily of the poultry industry, to reduce the likelihood of contact between domestic stock and wild birds or infected water sources. This needs to be coupled with swift and complete culls of infected poultry flocks in the event of an outbreak. Further measures that should be considered include stricter controls on wild bird markets, and movements of domestic poultry. Such measures should be introduced worldwide. Countries currently free of the disease should consider a ban on imports of domestic poultry and wild birds for the pet trade from affected regions. Preventing public access to infected sites is also clearly a sensible precaution.
5. It is important that discussions of the issues relating to avian influenza should differentiate between the real problems caused by the spread of the disease within bird populations, especially within the poultry industry, and the theoretical risks of a human pandemic, which might not happen.
6. We fully recognise the potential for a human pandemic should the current viral strain increase its transmissibility through mutation or reassortment, thus facilitating human to human transfer of the disease, and in the absence of swift measures to safeguard public health. We also recognise the impact the current strain is having on local economies forced into culls of domestic flocks, and the potential for greater financial impact on the poultry industry.
7. In addition to the impact of the disease on economics and livelihoods, and the potential impacts for human health, there are also potential implications for conservation. For instance, it is estimated that somewhere between 5% and 10% of the world population of the Bar-headed Goose, *Anser indicus* perished in the recent outbreak in China.

The World Health Organization (WHO), The Office International des Epizooties (OIE) and the Food and Agriculture Organization (FAO) all concur that "the control of avian influenza infection in wild bird populations is not feasible and should not be attempted." ([http://www.who.int/csr/don/2005\\_08\\_18/](http://www.who.int/csr/don/2005_08_18/)

[en/index.html](http://www.who.int/csr/don/2005_08_18/en/index.html)) A version of this statement has also been endorsed by the Royal Society for the Protection of Birds, Wildfowl and Wetlands Trust and British Trust for Ornithology

### **Avian flu and birdwatchers**

During the second half of September, representatives from the RSPB (BirdLife in the UK) and other UK bird NGOs including the BTO and WWT, were involved in discussions with the relevant UK government agencies, principally to advise on the latest knowledge of the origins of birds wintering in the UK, migration routes and timing, and bird distributions within the UK. Such information is derived in large part from the hard work of volunteers working on schemes such as the BTO Ringing Scheme and the BTO/WWT/RSPB/JNCC Wetland Bird Survey (WeBS). As a result of this the RSPB have published some guidelines for birdwatchers in relation to the disease.

### **Wetlands International's Position statement Avian influenza**

Avian influenza or bird flu is an infectious group of diseases caused by the influenza virus, which belongs to the Orthomyxoviridae family. Three types of influenza viruses, A, B and C are known, but so far only influenza A viruses have been isolated from domestic and wild bird species, which are the natural reservoirs of these viruses. Influenza A viruses are further divided into subtypes determined by haemagglutination (H) and neuraminidase (N) antigens. To date, nine subtypes of H and fifteen subtypes of N antigen have been identified. While there are strains of this virus which are not virulent and do not kill the birds, some forms of the virus are highly pathogenic. The highly pathogenic Avian influenza (HPAI) strains can cause illness and mortality approaching 100%. There are no known natural reservoirs of HPAI. There is no concrete proof yet that waterbirds infected with such a highly pathogenic strain can survive, have the ability to migrate and be capable of transmitting the virus to other birds, poultry animals or humans.

The Avian influenza virus does not normally infect species other than birds, but strains have been recorded infrequently in a range of other animal species, including pig, tiger, and whale. The Avian influenza virus does not normally infect humans. However, these viruses have the tendency to mutate and may occasionally spread to other animals and to humans. In particular, there have been cases of humans becoming infected with certain highly

pathogenic subtypes of the avian flu virus due to direct contact with or consumption of diseased birds.

### **Recent influenza Outbreaks**

Several avian influenza outbreaks have been recorded in Asia in recent years. In 1997, the first case an outbreak of avian influenza was followed by deaths of a few people in Hong Kong. This resulted in a rapid response by the government authorities resulting in the culling of all poultry. The trade of poultry and wild birds in live markets in crowded conditions is believed to have provided conditions that were conducive for transmission of viruses between birds and onwards to humans.

These outbreaks in the poultry industry since 2003 are having major economic and social impacts in China, Vietnam, Thailand, Cambodia, Japan, Malaysia and Indonesia. Losses of several million US dollars have been incurred due the culling of more than 140 million birds (chickens, ducks and geese) and export bans of their meat and eggs (as at July 2005). Other poultry affected include quail and turkey. In early August 2005, the virus has been detected in poultry in southern Russia and Kazakhstan, indicating a northwest spread of the disease.

The spread of influenza viruses in human beings have resulted in the deaths of over 65 people in the last two years in China, Hong Kong, Vietnam, Thailand and Indonesia. The World Health Organisation (WHO) and Food and Agriculture Organisation (FAO) have warned of likely rapid regional spread of the disease and of possible influenza pandemics.

While the precise causes of spread of the disease are not known, a number of likely routes are considered, including unhygienic poultry practices, transportation and sale of live poultry, poultry products (meat and eggs), movement of humans and vehicles between poultry farms, legal and illegal trade in wild birds and normal movements of wild migratory birds, particularly ducks.

### **Deaths of Wild Birds**

From May 2005 onwards, a number of deaths of Waterbirds were reported at Qinghai Lake in the People's Republic of China. The exact number of birds that were found dead remains unclear, with reports of over 6,000 birds of over eight species during the months of May-July 2005. Limited sampling and studies of the genetic make up of viruses found in five species (Barheaded Goose, *Anser indicus*, Brownheaded Gull, *Larus brunnicephalus*, Great Blackheaded (Pallas) Gull,

*Larus ichthyaetus*, Great Cormorant, *Phalacrocorax carbo* and Ruddy Shelduck, *Tadorna ferruginea*) were found to be that of the highly pathogenic avian influenza strain A/H5N1 <Nature and Science>. The source of the virus, location of infection and mechanism of transmission to and between these birds remains unknown. On 28<sup>th</sup> October 2005 mass deaths of wild geese in two provinces of China was confirmed. But scientists were sceptical, not revealing its full findings. The Chinese did not come out with full facts and figures even on SARS outbreak. So transparency and exchange of complete information is vital, in containing the spread of diseases like bird flu and SARS.

The first and only outbreak in wild birds to cause significant deaths was reported in 1961 in South Africa in Common Terns *Sterna hirundo* and by another influenza strain (H5N3). The influenza virus occurs naturally in wild birds, although most strains are not virulent. However, H5N1, has been found in one or very few individuals of at least 11 species of wild birds in Asia since 2003, including Peregrine Falcon (*Falco peregrinus*) Grey Heron (*Ardea cinerea*) Little Egret (*Egretta garzetta*) Open-billed Stork (*Anastomus oscitans*) Bar-headed Goose (*Anser indicus*) Mallard (*Anas platyrhynchos*) Ruddy Shelduck (*Tadorna ferruginea*) Great black-headed Gull (*Larus ichthyaetus*) Brown-headed Gull (*Larus brunnicephalus*) Magpie (*Pica pica*) and Jungle Crow (*Corvus macrorhynchos*).

### **Potential roles of birds (and their products) in dissemination of Avian diseases**

The interaction between humans, wildbirds and pet birds and their products in a number of ways increase the possibility of dissemination of diseases within a country and around the world. This is illustrated by the following examples:

**Bird Trade** - domestic and international trade in wild and cage birds, involves millions of individuals annually, and the frequent occurrence of mixed markets could allow virus to pass between species and cross borders.

- \* There is reason to believe that the trade in laughing thrushes (*Garrulax spp*15) could provide a potential avenue for dissemination of Avian influenza virus from China to Indonesia a spread that does not lend itself to explanation by natural migration, especially in light of the fact that there are no reported outbreaks in either Malaysia or the Philippines.

- \* In 2005, H5N1 type A influenza virus was isolated from two Mountain Hawk Eagles, *Spizaetus nipalensis* illegally imported to Belgium from Thailand; it was believed that the birds may have been fed on infected chicken meat.
- \* Another highly pathogenic paramyxovirus for domestic poultry entered Italy through a shipment of Parrots, Lovebirds, and Finches for the pet trade that had been imported from Pakistan.

### **Trade of Bird Products**

The trade of bird meat and meat products, eggs and egg products, feathers are capable of carrying viruses. Infected domestic duck meat exported from China to Korea and Japan have been found to contain H5N1 in 2003-2004.

### **Merit Release –**

The religious practice of “merit release” in parts of South and Southeast Asia results in captive birds rejoining wild populations and may enable transmission of avian diseases.

- \* In 2004, in Vientiane, Laos, cage birds apparently have been released due to fears of potential H5N1 infection.

**Cock Fighting** – the practice of cock fighting in parts of South and Southeast Asia and transport of these birds to different locations may enable movement of Avian diseases.

### **Movements of waterbirds in the Asia-Pacific region**

See <http://www.wetlands.org/IWC/awc/waterbirdstrategy/Intro.htm>

The breeding ranges of many migratory waterbirds covers the Qinghai Lake area and western China. lies on the cross-roads of the major flyways of waterbirds in Asia:

- \* Central Asian Flyway
- \* East Asian Australasian Flyway

Birds depend on the wetlands and other habitats in this region to breed and for those species that nest further north across Siberia, as staging areas of waterbirds on their annual migrations south. The detailed picture of migration within the region is complex, as different species and populations vary in their migration strategies. Some populations do not follow these general flyways and spend the non-breeding period in areas covered by two or more

flyways. There is also considerable overlap between the flyway areas, especially at northern latitudes where the birds breed.

A preliminary analysis of the waterbird distribution patterns indicate that the ranges of at least 24 populations of migratory waterbirds that spend the northern winter in South Asia are shared with the three sites affected by the 2005 H5N1 outbreaks in China.

Furthermore, evidence of migration of three species (Barheaded Goose, Great Black-headed Gull and Great Cormorant) between Qinghai Hu and South Asia (India and Bangladesh) has been proven through recoveries of ringed birds. Despite the large volume of work undertaken by many groups in different countries across the region, there has been not been adequate collation of the available information to define the precise migration routes of all waterbird species across these countries. As a result, there are only very few recoveries of these birds, precluding a comprehensive analysis of the migratory pathways, timing of movements and staging grounds and major areas of concentration at different times of the year.

Monitoring of waterbirds across the country is being undertaken annually during January under the Asian Waterbird Census, a programme coordinated regionally by Wetlands International. This programme provides the primary basis for understanding the distribution of waterbirds at one time of the year. An extension and strengthening of the programme to cover additional sites and other periods of the year is necessary to collect more comprehensive information on the movements of waterbirds within the country and migration patterns is required.

South, Southeast Asia and Australasia is major non-breeding (wintering) ground for different Waterbird populations from east (China).

There remains a strong possibility of the non-breeding grounds in South Asia serving as a stepping stone for the virus to spread to Europe through migratory birds through interactions of these different populations.

### **Interaction of Avian influenza between humans, birds and other animals**

There is also a growing concern that the H5N1 may recombine and spread to humans causing a regional or global flu pandemic that could quickly kill millions of people. Such a fear or a possibility will mean that drastic steps may be taken to control birds and this could be done in an uncontrolled and unnecessary

way, such that many wild birds could be killed. In Thailand in 2004, there was a decision to cull wild birds following the identification of H5N1 in colonies of Asian Open-bill Stork. The stork nests in colonies, some of which are near chicken farms. It was believed that poultry droppings that were being allowed to go down drains into where wild birds and pigs were feeding could have been a source of spread of the infection from domestic to wild birds. A government decision encouraged by public opinion did not allow this culling to take place.

The latest H5N1 isolates from Qinghai Lake are particularly lethal, killing laboratory mice and chickens in a day or more and appears to have been readily transmissible among migratory birds at the Lake. It has not yet been known to spread between humans but scientists say it could mutate to a form passed between people.

A proactive approach involving multiple agencies responsible for poultry industry, human health and wildlife in the region to take actions to enable early detection of the virus, to take preventive measures to minimize the spread to humans, poultry, wild birds and animals and develop appropriate responses in the event of further outbreaks.

### ***Position statement on Avian influenza***

Issued by the Joint Nature Conservation Committee on behalf of English Nature, Countryside Council for Wales, Scottish Natural Heritage and Council for Nature Conservation and the Countryside Northern Ireland.

### ***Background***

Avian influenza is widespread in populations of wild birds, but typically has low lethality (so-called Low Pathogenic Avian Influenza - LPAI). There is current concern as to the occurrence of a highly virulent form of this virus (Highly Pathogenic Avian Influenza - HPAI - of the form H5N1) in South-East Asia since 2003 and its recent spread to Kazakhstan and Southern Russia. The means of this spread are not known. This concern arises, not only from the impacts of this infection on stocks of domestic poultry, but especially from the risk of human infection with HPAI as well as the theoretical potential that HPAI may mutate to a form that could spread between humans resulting in a global influenza pandemic.

There has been concern that westerly migrating wild birds may further spread HPAI from outbreaks in Russia to Europe. Long-term investment in programmes that monitor the numbers and

distribution of the UK's Waterbird populations, as well as information on bird movements gained from the National Ringing Scheme (organised by the British Trust for Ornithology), aid in evaluating this risk.

### ***Current levels of risk***

It is known that only a small number of the species of migratory waterbirds arriving in the UK this autumn will potentially come from the outbreak area to the east of the Urals.

The probability of infected birds arriving in the UK will depend on the proportion of wild birds in affected areas that have come into contact with the infection, the transmission rate of the virus, the mortality rate and incubation period for HPAI, and the likelihood that an infected individual could undertake a long distance migration from an outbreak area. These factors are currently difficult to quantify.

Risk depends also on the overall proportion of the concerned populations from the infected areas that migrate to the UK. For most species, this proportion is believed to be low. It will also vary seasonally, as in any species, influenza viruses are more prevalent in some seasons than others. Risk factors will change should the current outbreak spread westwards, since more migratory species would then be potentially available as vectors.

Overall our advice to the Department for Environment, Food and Rural Affairs (DEFRA) and the devolved administrations is that although a risk of introduction of HPAI by migrating birds does exist, the level of this risk is currently considered to be low as few migrating birds reaching the UK are likely to originate from currently infected areas. However, we currently have insufficient information on viral behaviour and the ability of infected birds to migrate to fully assess the risk at this stage.

### ***Next steps***

The UK statutory agencies are committed to assisting UK government, the devolved administrations, and others to monitor the current situation. To this end we will contribute our expertise and participate in a Working Group established by DEFRA and the devolved administrations to assess the risk that migrating birds might transport HPAI to Europe.

Contribute to contingency planning being currently undertaken by DEFRA and the devolved administrations in the event of an outbreak of HPAI in the UK.



Support DEFRA and the devolved administrations in liaising with other EU Member States and the international community on avian influenza issues.

Assessment of UK risk depends on understanding the spread of the disease internationally, as well as those measures put in place to co-ordinate surveillance of influenza in both wild and domestic birds. We will accordingly work with Wetlands International, especially through its *ad hoc* coordination unit, and other international organisations to develop international understanding so as to provide this wider context to the UK government and devolved administrations, the European Union and other relevant bodies.

Continue to support the BTO/WWT/RSPB/JNCC Wetland Bird Survey and BTO National Ringing Scheme as fundamental sources of information that aid the assessment of current risk.

We will work with others to develop and disseminate clear health and safety guidance for individuals whose activities may bring them into contact with potentially infected birds, such as bird ringers and hunters.

We will encourage relevant research at national and international scales, specifically in the following areas:

Clarification of the nature of migratory routes and timings for key migratory species; and further development of existing ecological monitoring of these populations.

Clarification of the virus behaviour in different waterbird populations, especially viral incubation periods, the infectious period in birds, symptoms in wild birds, as well as survival rates. We will keep our position under review and provide updated statements as the situation requires.

### ***Random Notes from different sources***

H5N1, a strain of avian influenza called the bird flu, is the most likely candidate. The largely Southeast Asian disease is commonly found in birds but also occurs in mammals like pigs, cats, and humans. It has killed several dozen people, but as of yet it cannot be easily transferred from person to person and so has not developed into a pandemic outbreak.

"We know that all documented pandemic episodes have involved the emergence of a completely new strain," Garcia-Sastre said. "That happened in 1918, 1957, and in 1968."

But Robert Webster of St. Jude Children's Research Hospital in Memphis has studied flu viruses for 40 years and has never seen the likes of [this] one. "This virus right from scratch is probably the worst influenza virus, in terms of being highly pathogenic, that I've ever seen or worked with," Webster says. Not only is it frighteningly lethal to chickens, which can die within hours of exposure, swollen and hemorrhaging, but it kills mammals from lab mice to tigers with similar efficiency. Here and there people have come down with it too, catching it from infected poultry. Half the known cases have died.

In those deaths many public health experts hear the distant rumblings of a catastrophe. So far this virus—classified as H5N1 for two proteins that stud its surface like spikes on a mace—isn't good at passing from birds to people, let alone from one person to the next. "It can make that first step across, but then it doesn't spread easily from human to human," says Webster. "Thank God. Or else we'd be in big trouble."

Analysis of the 1918 strain revealed several mutations also found in H5N1. The findings suggest that both strains share an ability to jump directly to humans from other animals without having to first combine with a flu strain already adapted to humans.

The sequence evidence from 1918 suggests that the virus is from completely avian origins," said Adolfo Garcia-Sastre, a microbiologist at Mount Sinai School of Medicine in New York City.

Dr. Julie Gerberding, an international expert on bird flu has called upon the humanity to maintain perpetual vigilance and has said that it will be an irresponsible act to under-estimate the virulence of the bird flu.

The President of United States of America has already drawn up a plan to tackle the threat of the bird flu by placing before the Congress a colossal US \$ 7 Billion budget for tackling the bird flu threat.

Some 88 countries have joined in the international effort to cope up with the bird flu pandemic.

Bird Flu cannot be prevented but the severity of the epidemic can be contained to some extent, if adequate measures are taken up before hand.

Better preparedness includes Cell Culture Technology for the production of the vaccine. But we have only 1950's vaccine technology which is antiquated, time consuming (may take up to six months to produce an effective vaccine) and the demands cannot be coped up.



The response has to be very rapid because unlike natural calamities like Tsunami, Cyclone or earthquake, which might strike at a particular place for a brief period, the bird flu can strike at will. It can strike simultaneously at many spots across the globe and may continue to spread virulently for months if not years. This is this century's greatest challenge to the humanity as yet.

### ***Model Mimics Spread of Asian Outbreak***

The study team used data from the Thai 2000 census and from previous studies of social networks in Thailand's rural Nang Rong district. The researchers attempted to replicate the ways in which an outbreak would spread through a rural population of some 500,000 people.

The model simulated a flu's movement and person-to-person interactions at all levels of society, from "close contact" environments—like homes, schools, and workplaces—to more casual contacts in places such as markets and temples.

Beginning with a single infected person, the model projected numerous scenarios of viral spread and development. The spread scenarios were largely based on the average number of people that each infected person is likely to infect.

Until 1997 scientists believed that it was impossible for birds to directly infect humans with H5N1. But an outbreak in Hong Kong in 1997 that killed six of 18 people infected with the virus proved the contrary.

Though H1, H2, and H3 influenza viruses now circulate within the human population every flu season, each one triggered a pandemic upon its debut.

One approach to preventing a pandemic has been to eliminate the virus from its animal reservoir by killing millions of chickens. But this is economically devastating to countries like Thailand, which is the fourth largest producer and exporter of chickens. Almost a hundred million chickens have died or been culled since the 2004 outbreak.

Robert Cook, chief veterinarian at the Bronx-based Wildlife Conservation Society in New York, believes that a global surveillance program would be a vital early warning system for spotting new potential pandemics. Such a system should bring together disease data from wildlife, livestock, and humans.

The WHO will hold an informal meeting in Geneva on November 11 for vaccine makers and representatives

from government and regulatory agencies to discuss a pandemic vaccine project.

"We can't eradicate this virus any time soon," said Tim Uyeki, a medical epidemiologist in the influenza branch of the Centers for Disease Control and Prevention in Atlanta, Georgia. "Even if infected poultry are culled, the virus persists in the feces and soil under certain environmental conditions. Unless you could disinfect the entire areas with H5N1 contamination, the virus could continue to spread to healthy poultry."

"As H5N1 continues to circulate in poultry and evolve, the virus will become an increasing public health threat. It's a ticking time bomb," Uyeki said.

In two separate studies, researchers from the Medical Research Council in London showed that the virus likely derived from an avian virus and retained some key characteristics of its avian precursor that caught the human immune system off-guard.

Although the discovery will probably not have an immediate impact on the current outbreak of chicken flu in Asia, the work will help scientists better understand flu viruses and their transmission from birds to humans.

The new evidence suggests that "receptor binding," the initial event in virus infection in which a foreign virus mixes with human proteins, is perhaps more important than the virulence of the virus in determining risk of transmission.

"This paper is important because of the knowledge it brings about how these viruses, which originate in birds, can jump to humans," Sir John Skehel, the Medical Research Council's lead scientist on the project, said in a prepared statement. "This allows us to track and monitor the changes in the virus for public health purposes, even though it does not allow us to predict or prevent future forms of flu."

But only Vietnam and Thailand have seen human deaths. Most human cases have been traced to contact with sick birds, and even though human-to-human transmission has not been ruled out in the case of one Vietnamese family, officials say there is no sign of a new strain that will infect many people.

However, experts say the wide range of the outbreak boosts chances the virus could mix with a human flu virus and create a hybrid that may develop into a global menace.

### ***How is infection with H5N1 virus in humans treated?***

The H5N1 virus currently infecting birds in Asia that has caused human illness and death is resistant to amantadine and rimantadine, two antiviral medications commonly used for influenza. Two other antiviral medications, oseltamavir and zanamavir, would probably work to treat flu caused by the H5N1 virus, though studies still need to be done to prove that they work.

### ***Is there a vaccine to protect humans from H5N1 virus?***

There currently is no vaccine to protect humans against the H5N1 virus that is being seen in Asia. However, vaccine development efforts are under way. Research studies to test a vaccine to protect humans against H5N1 virus began in April 2005. (Researchers are also working on a vaccine against H9N2, another bird flu virus subtype.) For more information about the H5N1 vaccine development process, visit the National Institutes of Health website.

### ***Village closed off***

Meanwhile a turkey farmer in north-western Turkey reported last week that 1700 of his birds had died, and Turkey's Anatolia news agency said the cause was an H5 flu virus. A 3-kilometre radius around the village has been closed off and all birds and stray dogs within it are being killed.

### ***Precautionary measures***

Bird owners should

- \* Erect pens to keep domesticated poultry away from wild birds
- \* Keep domestic waterfowl separate from poultry where the water-fowl have access to the same water as wild water birds;
- \* Be alert to the symptoms of avian influenza in birds and quickly report any suspicions to the veterinary authorities.

Commercial poultry producers should apply good biosecurity measures including

- \* Maintaining a high level security regarding all traffic coming onto poultry farms and a very high standard of hygiene to minimize the spread of the disease.
- \* Bird proofing of poultry sheds to prevent contact between wild bird, especially wild water bird and poultry;

- \* Keeping record and reporting sudden decrease in production
- \* Ensuring that all sick and dead birds are checked by an experienced veterinarian and that sample are submitted to the regional laboratory.
- \* Avoid open air markets where eggs and birds are sold under unsanitary conditions.

Poultry in the vicinity of the wetlands or any where else where wild water birds congregate could be at higher risk, so surveillance in these areas need to be reinforced.

An easy to read broucher published by the FAO "Prevention and control of avian flu in small scale poultry: A guide for veterinary paraprofessionals in Cambodia", which can be freely downloaded from the internet, gives simple tips that small holders can follow to protect their flocks. Keep the bird in protected environment ideally, poultry should be kept in a closed building. Control entry into the farm, people, wheeled vehicles, implements, animals brought from elsewhere and even dogs or cats carrying dead animals can bring the virus to the farm. Visitors should be kept away from where poultry live and eat. A bucket of water and soap kept handy helps reduce the risk of infection.

### ***Control measures***

The main measures available to prevent, control and eradicate HPAI are:

- \* Effective disease surveillance for early detection and reporting of outbreaks.
- \* Enhanced biosecurity of poultry farms and associated premises.
- \* Control of movement of birds and products that may contain virus.
- \* Rapid, humane destruction of infected poultry and poultry at high risk of infection.
- \* Disposal of carcasses and potentially infective material in a biosecure manner.
- \* The proper use of vaccination.

The role of wild birds in spread of HPAI H5N1 viruses remains unresolved though some scientists believe that. Circumstantial evidence suggests limited local infection of resident wild birds, but transfer of H5N1 HPAI viruses outside the outbreak zones by migratory birds has not been substantiated. Wild waterfowl, especially ducks, are natural reservoirs of Avian Influenza Virus (AIV) and are an important source of infection in domestic waterfowl and poultry and provide a reservoir of all H subtypes except H13.

FAO recommends against the destruction of wild birds or their habitat. Rather, farm biosecurity must be enhanced. Efforts to destroy wild birds or their habitat are likely to result in dispersal of the population and to have little effect on risk or the course of HPAI infection in commercial poultry. Rather, authorities should take action to limit the exposure of farmed chickens and other poultry to wild birds by improving the biosecurity of farming enterprises.

Wild birds may come into contact with farmed poultry directly or indirectly (via contamination of feed and water). The latter route is especially important for farmed ducks reared on ponds and for poultry whose drinking water is obtained from ponds. Influenza viruses target the gastrointestinal tract of waterfowl and ducks can shed virus for as long as 30 days. As one of the wild birds' symptoms is diarrhoea, it could mean the virus would spread in contaminated water. Influenza viruses can persist and retain infectivity in water (> 30 days at 0°C and up to 4 days at 22°C).

### Recommended Steps

Based on available evidence, India seems under prepared to effectively deal with a threat of an outbreak of the H5N1 virus. As it seems well established now that the virus in their breeding grounds may have affected our wintering species, it is more likely this year that some migrating birds can carry the virus to India.

Extinguishing avian flu in poultry and pigs is the job of national agriculture and veterinary departments, the United Nations' Food and Agriculture Organization, and the World Organisation for Animal Health (OIE). The public-health aspects are the responsibility of health departments and the World Health Organization (WHO). This international coalition is shaky and far from united or sure in its purpose. Its efforts are grossly under funded, and undermined at every turn by various conflicts. So, each country really has to be ready to fight the virus on its own and the onus is on us to take the necessary steps to develop our own preparedness plans. With the disease firmly and widely entrenched in Asia, it is believed that the spread cannot be stopped and it would take up to a decade to rid the region of the virus. But preparedness will reduce its impact and key to containment could be:

- \* Preparing a widely circulated master plan to control the spread of the virus
- \* Epidemiological intelligence
- \* Disease surveillance
- \* Wild bird species recognition
- \* Understanding bird distribution and habitat usage
- \* Research into biology, genetics and antigens of avian, mammalian and human influenza viruses.
- \* Disease prevention and control through
- \* Vaccination of poultry in affected areas
- \* Keeping domestic poultry separate from wild birds in affected areas.

The U.N. Food and Agriculture Organization, advises against killing wild birds to contain the outbreak. Aside from ethical reasons, mass killing leads to dispersion of birds to new areas and with it the dispersion of the virus over much larger areas. Instead, it recommends surveillance and prevention efforts focused on vaccination of poultry in areas at risk and keeping domestic animals separate from wild birds.

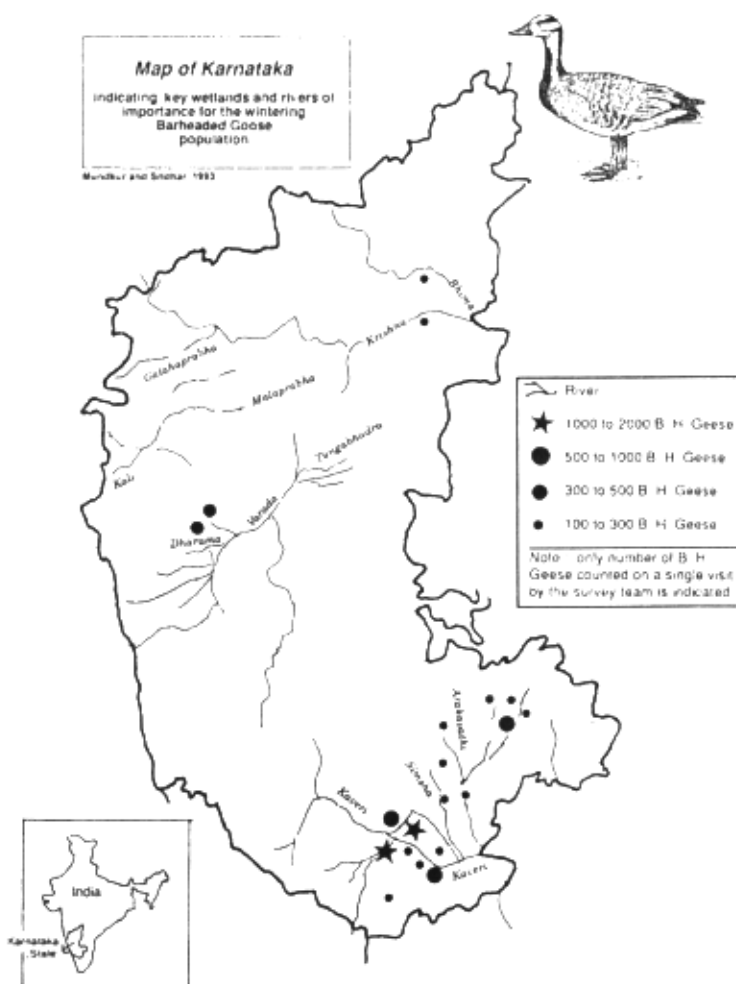


Fig.1.

**Table 1 List of important wetlands for monitoring Barheaded geese population in Karnataka, south India (Source: Mundkur and Sridhar, 1993)**

| No. of B.H. Geese | Wetlands district           | Co-ordinates  |
|-------------------|-----------------------------|---------------|
| 1001 to 2000      | Hadinaru, Mysore            | N1210E7645    |
|                   | Kaggalipura*, Mysore        | N 1216 E 7653 |
| 501 to 1000       | Hoskote, Bangalore          | N1308E7777    |
|                   | Yeriyur Kere, Mysore        | N1204E7702    |
|                   | Chikkaballi, Mysore         | N 1240 E 7654 |
| 301 to 500        | Akkialur, Dharwad           | N1445E7510    |
|                   | Naregul, Dharwad            | N1447E7505    |
| 101 to 300        | T.G. Halli, Bangalore       | N1277E7735    |
|                   | Tailur, Mandya              | N1297E7708    |
|                   | Karanji Kere, Mysore        | N1217E7640    |
|                   | Budigere Ammanni, Bangalore | N1315E7775    |
|                   | Melina Thota, Bangalore     | N1327E7772    |
|                   | Kunigal Dodda Kere, Tumkur  | N1302E7702    |
|                   | Byramangala, Bangalore      | N1277E7743    |
|                   | Merchad Tank, Raichur       | N1615E7720    |
|                   | Mare Halli Kere, Mysore     | N1221E7703    |
|                   | Yedeur Gaddahalla, Mysore   | N1155E7655    |
|                   | Halavarada Kere, Mysore     | 1211E7654     |
|                   | Dasarahalli, Bangalore      | N1319E7743    |
|                   | Khanapur Tank, Gulbarga     | N1645E7702    |

Barheaded geese are frequently implicated as carriers of the disease causing viruses. Mundkur and Sridhar (1993) indicated wintering sites of the bird in Karnataka (Table 1). Authorities are especially advised to look out for the first symptoms of disease among the affected poultry farms in these areas. Also they should educate the poultry farmers about the need to know keep their birds indoors and away from wild birds.

### **Actions Needed**

There is an urgent need to take proactive and immediate actions to understand the occurrence of H5N1 and other HPAI strains in the region within the populations of domestic poultry, migratory and resident birds, animals and people. As this will require implementation of a range short term and medium term measures, the following recommendations are considered relevant in each country.

### **Assessing the potential role of waterbirds**

1. Prepare comprehensive risk assessment maps based on sound information on the distribution of waterbirds, poultry and other factors. This will permit us to determine if and where migratory birds and resident birds (including chickens and ducks) and other possible influenza vectors may intermingle. This will enable us to better predict and take preventive actions for future outbreaks.
2. Undertake immediate collation and collect information on waterbirds and other birds that are needed to underpin the development of the comprehensive risk assessments (this requires a large scale multiyear programme). As information on this is dispersed and there are many gaps, the following actions are required:
  - Detailed studies to map year-round distributions of waterbirds,
  - Identify areas where birds stop during northward and southward migration and sites of concentration,
  - Identify precise migratory patterns of waterbirds and locations for first arrivals of migratory waterbirds in India (through use of satellite transmitters to mark and track priority species and use of colour marking techniques such as colour leg bands and neck collars for a range of migratory species), and
  - monitor numbers of waterbirds at strategic locations across the country, to determine patterns of usage of these areas at different times of the year and identify significant waterbird sickness and deaths.
3. Establish a comprehensive long-term sampling and testing programme of wild migratory and resident birds for H5N1 and other avian diseases across each country.
4. Establish quick response teams in each country to enable rapid travel to sites with birds suspected/reported to be dying or having died of avian diseases and collect samples of dead and living birds for virus testing.

### **Action on bird trade**

5. Consider implementing of a [temporary at least] ban of all international trade (import and export) of wildbirds between medium-high risk countries and the transportation between states/provinces within a country to prevent spread of the disease. (wild bird trade is prohibited in India under the Wildlife Protection Act of 1972, but the illegal trade exists in certain pockets)
6. Increase vigilance on illegal international trade of wild birds and pet birds to detect the movement of All.

### **National actions**

7. Seek advice and cooperation from international agencies such as FAO, WHO and others in using standardized techniques and protocols for collection of samples from wild birds and identifying viruses.
8. Develop mechanisms for real time information exchange and collaboration with countries on avian influenza and other bird diseases, movements of migratory birds and trade in wildlife, particularly birds. This includes more accurate and timely reporting to OIE and other agencies collecting and disseminating information.
9. Establishment in each country of the region, a high level multi-disciplinary task force drawing from the ministries of Environment and Forests, Human Health, Agriculture (Department of Animal Husbandry and Dairying, etc.), poultry industry, technical institutions with expertise in study of migration and monitoring of waterbirds and their habitats, epidemiology and virology to prioritise and steer action at the national and local levels.

### **Awareness raising**

10. Raise the level of public awareness of the issues related to avian diseases in poultry and wildlife to enable enhanced reporting and preventive actions.
11. Develop mechanisms to provide real time information to support improved public awareness campaigns on avian influenza and other bird diseases, movements of migratory birds and trade in wildlife, particularly birds.

### **Poultry and animal husbandry-related**

12. Improve the biosafety standards in the poultry and animal husbandry related industry in each country – by working closely with international agencies such as FAO.
13. Increase the level of surveillance for influenza-related viruses in poultry across each country.
14. Decrease possible interactions between domestic poultry and wild birds.

### **Guidelines issued by the Joint Director of High Security Animal Disease Laboratory, Bhopal**

Dr. Hare Krishna Pradhan, Head of High Security Animal Disease laboratory, Bhopal, has issued some guidelines for collection of samples for testing.

Normally waterfowls, most notably the ducks, carry the virus but do not suffer from the disease. When the virus comes to chicken or turkeys they are badly affected and depending on the pathogenicity of the virus the mortality even may reach to 100%. In mild

cases mortality is less. The affected birds show swelling of the head, nasal discharge, fever, diarrhea etc. If the symptoms prolong the comb and wattles, besides swollen, become necrotic. When there is high mortality it may be suspected for avian influenza. Such high mortality may also be seen in Ranikhet disease (New Castle disease). Hence there is a need to differentiate these two conditions.

Local vets must be contacted to collect samples for testing. They should use gloves and face mask while collecting samples. Blood serum, about 1-2ml, is needed to look for the antibody to avian influenza. This gives the information that the birds were infected. Isolation of the virus is needed to confirm the current infection. From live birds fresh fecal sample to be collected in phosphate buffered saline (PBS, pH7.2-7.4) and sent to our laboratory in ice packs. If the birds are dead samples from trachea, lungs, intestine be collected and preserved in the same manner. Fresh droppings could be a more efficient method. Says HSADL chief Dr H K Pradhan: "The easiest way to gather samples is collect droppings from areas where they roost."

According to HSADL's Dr B Patnaik, who along with Dr Pradhan and three other scientists, is working on the samples, the virus can survive for over 150 days in faeces in temperatures less than 25 degree C. He said such detection will be early and help in taking preventive measures.

Bar-headed geese, large cormorants and black-headed gulls are among the species the Centre has asked state governments to look out for as suspected carriers.

The materials can be sent to High Security Animal Disease laboratory, Anand Nagar, Bhopal-462021 (MP) Dr. H.K. Pradhan, Joint Director, High Security Animal Disease Laboratory (HSADL), Indian Veterinary Research Institute (IVRI), Kota Road, Anand Nagar, Bhopal (M.P.)-462021, INDIA

### **Appeal by Wetlands International**

Wetlands International is keen to work with governments, international agencies and organisations, non-government organisations and others with a concern for human health, improving biosafety in the poultry industry and bird conservation to respond to the threat of avian influenza.

"We are committed to collaborating with likeminded bodies to improve our understanding of the migration routes and strategies of waterbird species across the region through improved monitoring, collation of information and collection of new data to support efforts to understand the potential impact of avian influenza on waterbirds and to ascertain their potential role in disease transmission".

## Conclusion

Ecological blunders are partly to be blamed for the spread of the epidemics like Mad-Cow disease, Bird Flu and Sars. They have manifested as a result of the genetic narrowness and inbreeding of commercial varieties of livestock and poultry. Reckless production and utilization of dreadful, revenue oriented man-made animal feeds, lacking in wholesomeness, are responsible for the influx of genetically weak, recessive and disease prone offsprings. They have limited or no resistance whatsoever and they readily fall victims to diseases. Poultry industry and livestock trade are generating huge quantities of waste materials, pollutants and pathogens, which are conducive for the virulent forms of viruses to emerge and flourish. Wild birds that travel from one continent to the other, are unwittingly being drawn into this vicious cycle. The current bird flu threat may morbidly afflict humans or leave them unscathed. But unless livestock and poultry trades are regulated and sanitation rules strictly enforced in every country, these disaster recipes will catalyze the advent of deadly virus strains, to perpetually torment global populations.

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# Impact of Copper Mining on Water Birds at Malanjkhand Copper Project: A Case Study

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## Introduction

Copper mines of Malanjkhand Copper Project of Hindustan Copper Limited is located just 10 Km South-West of the Kanha National Park boundary and is 7 Km from its Buffer Zone. The mining site lays in the catchment areas of the Banjar River. The Banjar River passes through the Buffer Zone and forms the Western boundary of the Kanha National Park in the Kanha Tiger Reserve.

The management plan of Kanha National Park and Kanha Tiger Reserve had been prepared by Panwar (n. d.), and latter on it was subsequently revised by Kotwal & Parihar (1999), and Rajesh Gopal & Shukla (n. d.) but no provision was prescribed as to assess the environmental impact of copper mines over the National Park. Moreover, Malanjkhand copper mines are situated so close to the Kanha Tiger Reserve but there had not been any initiations regarding environmental impact assessment of copper mines. However, this was taken for granted. "There is no external development threats what so ever the Malanjkhand Copper Complexes have no impact on the Park" Kotwal & Parihar, (1999).

Newton *et al.* (1986), updated the checklist of the Kanha Tiger Reserve but their observations were confined to the Park area i.e. core area only. Eric D' Cunha (2001) recorded some additional birds of the Park. The buffer zone remains untouched. However Kanoje (1995, 96, 97, 99, 2000, 2000 A, 2004) studied ecology of water birds of the Kanha National Park and recorded some new water birds in the buffer zone. The impact of copper mining on avifauna remains unnoticed at Malanjkhand copper mines.

The objective of this investigation is to study the impact of the contaminated water (with copper salts) on water birds at the copper mines area. This paper is the outcome of the "Investigation of developmental activities around Kanha Tiger Reserve," under Salim Ali Nature Conservation Fund (Kanoje, 2002) of the Bombay Natural History Society, Mumbai.

## The Study Site

**Copper Mines:** The copper mines of Malanjkhand Copper Project of Hindustan Copper Limited lies between latitude 22°, 00' North and 80°, 45' longitude East, in the Balaghat District in Madhya Pradesh. In the copper mines, deposits of copper are found as a sulphide, carbonate ores, and sometime in a free state. The ores of copper found are as follows.

Sulphide Ores : Chalcopryite  $\text{CuFeS}_2$   
Chalcocite  $\text{Cu}_2\text{S}$ ,  
Carbonate Ores : Malachites  $\text{CuCO}_3\text{Cu}(\text{OH})_2$ ,  
Azurite  $2\text{CuCO}_3\text{Cu}(\text{OH})_2$

In the Malanjkhand Copper Mines, the copper ores are excavated in the open cast mines. The huge mass of debris obtained from the crust are dumped.

**Ore Refining Plant:** The sulphide ores are concentrated in the ore refining plant by oil floating process. The ore is crushed and finally grounded and is thoroughly agitated with pine oil, lime and xanthate by blowing air through it. The froth produced with rich in copper sulphides by aeration through it. The froth produced with rich in copper sulphides by aeration is skimmed off and allowed to settle. The concentrate thus obtained contains 21-30% copper. The residue with water and sand is drained into the Tailing Dam by high current of water through pipelines. The waste-water from the Tailing Dam is recycled again for draining out waste material from the plant.

**Tailing Dam:** The Tailing Dam was constructed especially for dumping sand as a waste material obtained from the ore concentration plant. The sand piled along the periphery of the reservoir and the water containing copper salt is stored in the central part of the Tailing Dam. The sandy bed and the water storage areas are devoid of any vegetation except some scattered bushes and gives an appearance of a desert.

**Leaching Plant:** Crude copper is recovered from the carbonate ores in the Leaching Plant. The ores are directly treated with dilute sulphuric acid to get copper sulphate. Sulphuric acid is sprinkled over the piles

of broken ores. The ferrous sulphate with sulphuric acid is stored in the pit. The acidic solution is treated with scrap iron by immersing it in the solution. Iron displaces copper metal from copper sulphate in the form of a precipitated copper mud; called cement copper which is ready for refinery.

**Karamsara Tank:** Karamsara Tank is an old shallow reservoir constructed earlier for small irrigation purpose. It is close to the mine site where leaching plant and ore concentration plant is situated.

**Banjar River:** The water required for the ore refining and leaching plants is obtained from the Banjar River through diversion canal at Ramgarhi. The Copper Mines, Ore Concentration Plant, Tailing Dam, and Leaching plant are in the catchment area of the Banjar River.

**Ramgarhi Barrage:** At Ramgarhi, a barrage constructed on the Banjar River and river water is diverted for supplying water to the Copper Mines.

#### Material and Method

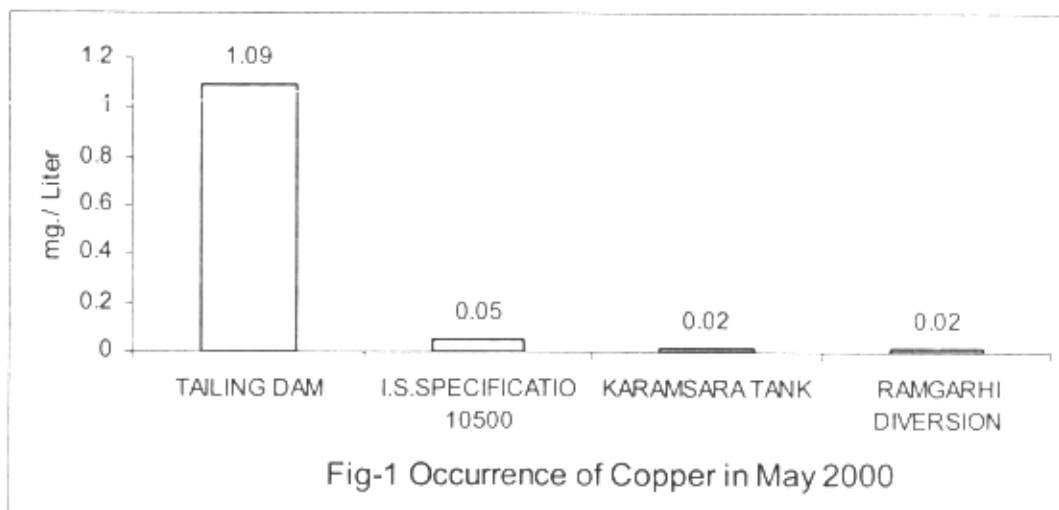
Visual observations were made at the Mines, Ore Refining Plant, Leaching Plant, Karamsara Tank, and Ramgarhi Diversion Barrage of Banjar River. Samples

of water were collected from the various sources of water, Ramgarhi Diversion, Tailing Dam and Karamsara Tank in the month of May 2000. Sampling was done in the peak summer season when the contamination of sources of water with copper salts are supposed to be at its highest level. Sample water of 500 ml was acidified with 2.5 ml concentrated nitric acid and sent to the Research Centre of the Madhya Pradesh Pollution Control Board at Bhopal for analysis. Emission spectroscopy used for the detection of the presence of copper and estimation of copper content. In the month of February 2000, the water birds were counted at Tailing Dam and Karamsara Tank.

#### Results and Discussion

**Occurrence of Copper Metal at the Various Sources of Water:** On 19-05-2000 in the Banjar River at Ramgarhi Diversion and Karamsara Tank, the copper content was same at 0.02 mg per litre. It is below the desirable limit of I. S. Specification, which is 0.05 mg. per litre. (Fig.-1). In the Tailing Dam the copper content was as high as 1.09 mg. / litre which is about 20 times than that of the Indian Standard specification. As the copper content in the water of the Banjar River and Karamsara Tank were same,

| TABLE-1                                                |                  |                                    |                          |
|--------------------------------------------------------|------------------|------------------------------------|--------------------------|
| OCCURRENCE OF COPPER METAL AT VARIOUS SOURCES OF WATER |                  |                                    |                          |
| Sample Number                                          | Date of Sampling | Sources of Water                   | Copper Metal in mg/liter |
| 1                                                      | 19-05-2000       | Banjar River at Ramgarhi Diversion | 0.02                     |
| 2                                                      | 19-05-2000       | Tailing Dam at Malanjkhanda        | 1.09                     |
| 3                                                      | 19-05-2000       | Karamsara Tank Malanjkhanda        | 0.02                     |



therefore it can be concluded that the Karamsara Tank is not polluted with copper salt from the copper mines, whereas the Tailing dam is highly contaminated with copper salts.

**Occurrence of Water Birds:** The Tailing Dam and the Karamsara Tank are close to each other and are similar wetland habitats except that the Tailing Dam, which is contaminated with copper salt; therefore, both can be compared as a similar habitat of water birds. In the month of February 2000, the water birds counts in the Karamsara Tank, 9 species of water birds were seen where as in the highly polluted Tailing

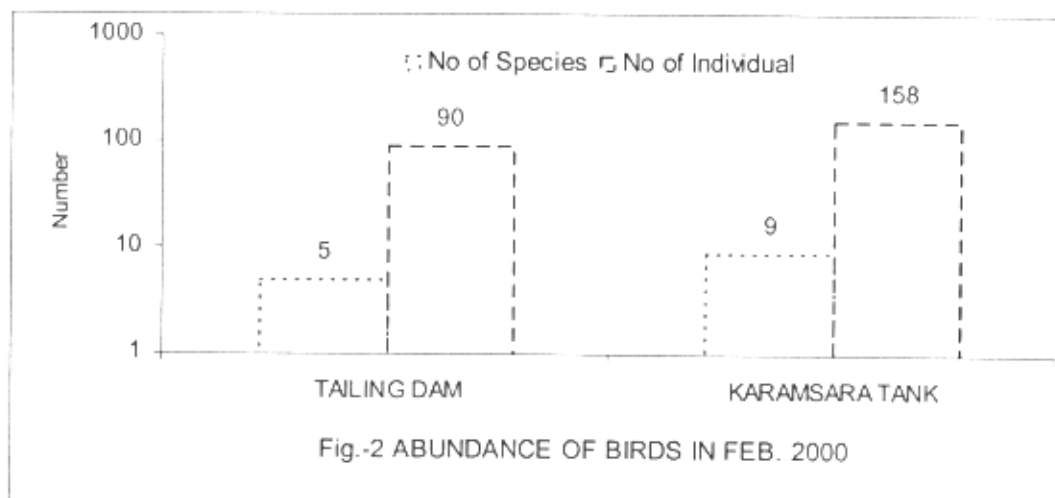
Dam only 5 species. Total numbers of water bird count was 158 in the Karamsara Tank, where as 90 in the Tailing Dam (Fig.-2). Avifaunal diversity is double and bird abundance is 1.75 times in the Karamsara Tank than the Tailing Dam.

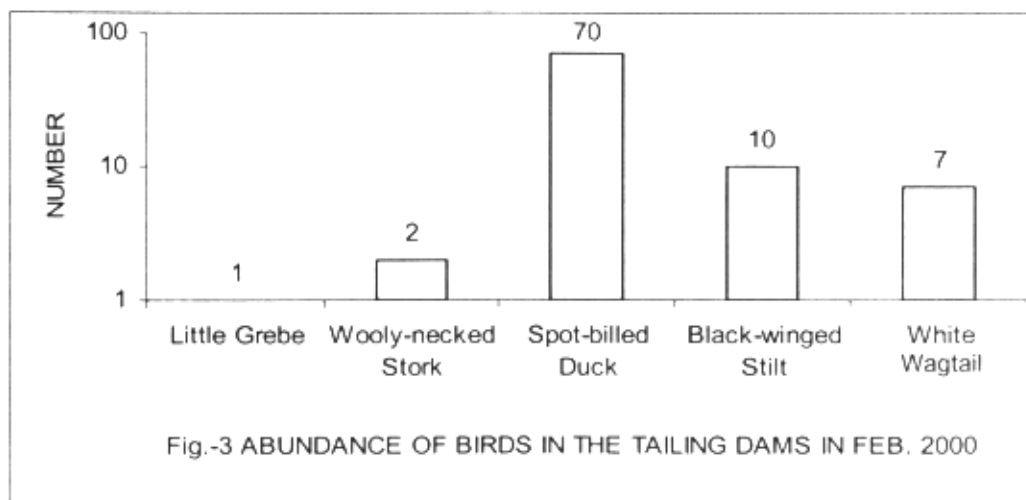
**Relative Abundance of Birds in the Tailing Dam:**

In the Tailing Dam, there were only one individual of Little Grebe, 2 Woolly-necked Stork, 70 Spot-billed Duck, 10 Black-winged Stilt, and seven White Wagtails (Fig.-3). It is peculiar that there were great congregations of 70 Spot-billed Ducks in the Tailing Dam whereas it is rarely seen in such a large number

**TABLE - 2**  
**OCCURRENCE OF WATER BIRDS AT VARIOUS WETLAND SITES**

| S. No. | Species of Bird<br>Common / Scientific Names        | Number of Water Birds<br>Tailing Dam | Karamsara<br>Tank |
|--------|-----------------------------------------------------|--------------------------------------|-------------------|
| 1      | Little Grebe <i>Tachybaptus ruficollis</i>          | 1                                    | 9                 |
| 2      | Little Egret <i>Egretta garzetta</i>                | Nil                                  | 6                 |
| 3      | Cattle Egret <i>Bubulcus ibis</i>                   | Nil                                  | 96                |
| 4      | Indian Pond Heron <i>Ardeola grayii</i>             | Nil                                  | 21                |
| 5      | Wooly-necked Stork <i>Ciconia episcopus</i>         | 2                                    | Nil               |
| 6      | Black Ibis <i>Pseudibis papillosa</i>               | Nil                                  | 2                 |
| 7      | Spot-billed Duck <i>Anas poecilorhyncha</i>         | 70                                   | 3                 |
| 8      | Red-wattled Lapwing <i>Vanellus indicus</i>         | Nil                                  | 10                |
| 9      | Black-winged Stilt <i>Himantopus himantopus</i>     | 10                                   | 10                |
| 10     | White-breasted Kingfisher <i>Halcyon smyrnensis</i> | Nil                                  | 1                 |
| 11     | White Wagtail <i>Motacilla alba</i>                 | 7                                    | Nil               |
|        | Total                                               | 90                                   | 158               |





at one place. This indicates its affinity to water, the highly contaminated water with copper salt. Similarly, the presence of 10 Black winged stilt also shows its tolerance capacity of copper contents in the water. The same number of Black-winged Stilt has also been recorded in the Karamsara Tank. Black winged Stilt, which has not been recorded so far in the wetlands of the core zone, the Kanha National Park (Kanoje; 1999, Newton *et. al*; 1986, Eric D' Cunha; E. P. 2001), where the wetlands are free from any types of water pollution or contamination in the Core zone. However, it is present in the wetlands in the Buffer Zone. Black-winged Stilt is tolerant to a high level of pollution (Singh; *et. al*). Thus, the Spot-billed Duck and Black-winged Stilt may be treated as indicator species of polluted wetland habitat.

Copper intoxication can occur from water containing copper sulphate. Wild birds may suffer from gastroenteritis, greenish discoloration of the mucus, renal and hepatic degeneration.

The copper metal content of the sample water is of the order of 0.02 to 2.00 mg per litre. Therefore, a single sample is not sufficient for a desirable level of uncertainty. A pilot survey may be carried out to determine the number of samples to be taken at a time for the 95% desired level of confidence. In this case, 40 to 50 samples are required (personal communication from National Environmental Engineering Research Institute Nagpur). Therefore, the precise result may be obtained by taking a large number of samples. Seasonal variations may occur in the copper content. Therefore sampling may be done round the year or at least 6 times in a year with a regular interval of two months in the various seasons.

The Banjar River water may contain other heavy metals like lead, iron, mercury, manganese and other toxic elements such as antimony, arsenic, bismuth, cadmium therefore, analysis may be carried out for other toxic and heavy elements. Water birds are the good indicator of environment of wetlands. Therefore monitoring of bird population must be done regularly in these wetlands. The bird and fish has a high metabolic rate therefore are good bio-indicators. The heavy metals accumulate in a select body tissue (Murlidharan & Bakre; 1996). Samples of the different product and organs such as guano, feathers, brain, heart, liver, kidney, and muscles may be examined for the presence of any toxic substances.

Some chemical standards in monitoring the pollution is rather insisted but biological monitoring and bio-toxicity are rarely accounted for an ecosystems (Bhanumathi & Thirumurthi; 1995). Wetland fauna and flora show extreme sensitivity to changes in the quality of their environment and are indicator of the environmental condition of the habitat (Singh, *et. al*). This site is an ideal ecosystem for studying the effect of heavy metals on the water birds and comparing the results with other habitats.

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# Molecular Phylogenetic Approaches in the Study of Avian Disjunct Distributions and Double Invasions

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## Introduction

The biota of peninsular India and Sri Lanka offer a unique natural laboratory to study various biogeographic theories as well as speciation mechanisms due to the existence of two broad climatic zones in the Indian subcontinent. The first climatic zone, referred to as the wet zone, includes areas in northeast (NE) and southwest (SW) India as well as SW Sri Lanka. These areas receive over 250 cm of rainfall per year. The rest of the Indian subcontinent belongs to the second climatic zone, referred to as the dry zone, receiving between 50-100 cm of rainfall per year (Fig. 1).

## Material and Methods

An attempt has been made to discuss the phylogenetic approaches for studying bird distributions based on available literature.

## Results and Discussion

This difference in rainfall has resulted in stark differences in flora and fauna between the wet and dry zones. The major forest type in the wet zone is tropical evergreen forest; these forests harbor fauna that are evergreen forest specialists such as the Lion-tailed Macaque among mammals and the Frogmouth among birds. The dry zone, on the other hand, consists of a range of habitats from deciduous forest and scrub jungle to grassland. Here we find generalist species such as the Hanuman Langur and grassland specialists like the Great Indian Bustard.

An interesting outcome of this dichotomy in climate is the marked discontinuity in the distributions of many wet zone species in the Indian subcontinent. For example, among birds of the genus *Dicaeum* (flowerpeckers) the species *D. concolor* is found in

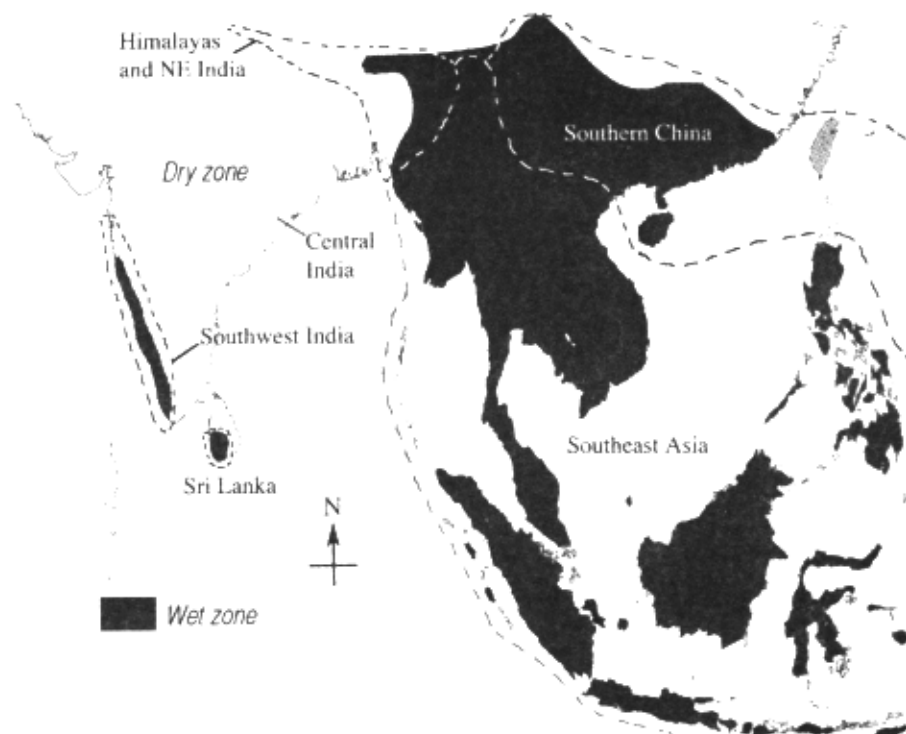


Figure 1: Map of tropical Asia showing the current extent of the wet zones.



the SW Indian wet zone, but not in the rest of the Indian subcontinent; they are again found 1500 km away in the wet zones of NE India and throughout southeast (SE) Asia. Thus, this species is distributed in India in two widely separated areas viz SW and NE India (Fig. 2). The intermediate dry zone is inhabited by another species, *D. erythrorhynchos*. There are several such cases of disjunct distributions of apparently closely-related taxa in the Indian subcontinent among mammals (Kurup, 1974), birds (Ali, 1969), fresh-water fishes and amphibians (Jayaram, 1974), reptiles (Das, 2002), and plants (Mani, 1974).

Most authors have invoked variations of either the dispersal or the vicariance biogeographic models to explain such disjunct distributions (Karanth, 2003). In addition, the current distribution patterns of some birds in the Indian subcontinent also suggest that both vicariance and dispersal have contributed to disjunct distribution of birds of the Indian subcontinent (Karanth, submitted). Both models would predict that the wet zone species of peninsular India are more closely related to the wet zone species from NE India than they are to the dry zone species of the Indian subcontinent. These models also suggest that the wet zone species arrived on peninsular India independently of the dry zone species. Thus there would have to be two colonization events or double

invasion, one of the wet zone species and the other of the dry zone species to explain the current distribution of various species in the Indian subcontinent. Double invasion occurs when two related populations/species arrive in an area at two different times (Ripley, 1949). The assumption here is that these species evolved in geographic isolation and have become sympatric secondarily through range expansion. For example, in the case of flowerpeckers, the wet zone specific *D. concolor* dispersed into peninsular India independently of the widely distributed dry zone species *D. erythrorhynchos* (Fig. 2). Table 1 has a list of other species pairs that exhibit similar distributional pattern.

The current classification scheme wherein wet zone populations of flowerpeckers are given the same species name supports disjunct distribution among *D. concolor*. In addition such examples of avian disjunct distribution suggest double invasion. But it must be noted that, the apparently disjunct distribution of some species might be an artifact of flawed classification, wherein distantly-related forms have been placed in the same taxonomic group based on overall morphological similarity or due to lack of morphological variation. The morphological similarity in turn might be a byproduct of independent adaptation (convergence) by different species to very similar ecological conditions in widely separated areas.

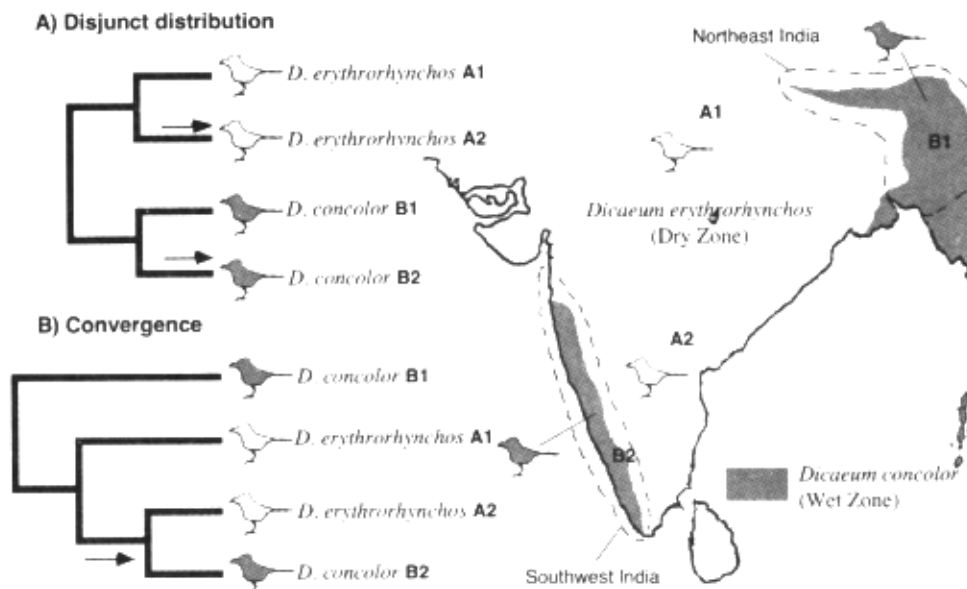


Figure 2: Predicted phylogenetic trees for disjunct distribution and convergence models discussed in the text. The wet zone species *D. concolor* has darker plumage than its dry zone counterpart *D. erythrorhynchos*. Arrows indicate colonization events; A1-2 and B1-2 are subpopulations of *D. erythrorhynchos* and *D. concolor* respectively.

Taking the example of flowerpeckers again, it is plausible that "*D. concolor*" of SW India (B2 in fig. 2) is more closely related to its neighbor in the dry zone *D. erythrorhynchos* (A2) than it is to *D. concolor* of NE India (B1). Here, convergence of morphological characters between "*D. concolor*" from SW and NE India would erroneously suggest a disjunct distribution. The wet zone species *D. concolor* has darker plumage than its dry zone counterpart *D. erythrorhynchos*. Recent study indicates that there are at the least seven avian species that are strong candidates for the convergence model (Karanth, submitted) (Table 1). Additionally, preliminary survey of molecular studies done on Indian species with disjunct distribution suggested that convergence is quite common (Karanth, 2003). This convergence model would predict a single faunal colonization of peninsular India with subsequent divergence into wet zone and dry zone forms. Thus, the first step in studying disjunct distributions is to determine if the observed pattern based on current classification is real (true disjunct) and not due to convergence i.e., an artifact of incorrect classification (false disjunct). Only if a truly disjunct pattern is verified can one assume double invasion in these groups and then go on to test if the observed pattern is due to a dispersal or vicariance event (Karanth, 2003). To tease apart true disjunction (double invasion) from false disjunction or convergence (single invasion), it is imperative that

we use molecular phylogenetic tools. This is because morphological characters can be deceptive in determining the evolutionary relationships (phylogeny) between species due to the problem of convergence.

These are two broad models, disjunct distribution and convergence, that can be tested using phylogenetic methods to better understand patterns of avian distribution. The topology of the molecular phylogenetic tree will be quite different for the two models presented above. In the case of the disjunct distribution model, the wet zone species of SW India are predicted to be more closely-related to the wet zone species from NE India than they are to the dry zone species of the Indian subcontinent. This model also suggests that the wet zone species of peninsular India arrived independently of the dry zone species. In the hypothetical molecular phylogeny illustrated in figure 2A the dry zone and wet zone species fall into two distinct mutually exclusive groups, suggesting that the wet zone species are more closely related to each other and that there have been two separate colonization events into peninsular India. It must be noted that, here the molecular phylogeny agrees with morphology-based classification scheme.

According to the convergence model the wet zone species from peninsular India are more closely related to their immediate neighbors in the dry zone than they are to the wet zone species from NE India. Here

Table 1: Distribution of wet zone species exhibiting disjunct distribution and their counterparts in the dry zone. NE: Northeast India; SW Southwest India.

| Wet Zone (SW & NE India)                                                                               | Dry Zone (Indian subcontinent)                             |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Plain flowerpecker<br><i>Dicaeum concolor</i>                                                          | Pale-billed flowerpecker<br><i>Dicaeum erythrorhynchos</i> |
| Lesser coucal<br><i>Centropus bengalensis</i>                                                          | Greater coucal<br><i>Centropus sinensis</i>                |
| Bright-headed cisticola<br><i>Cisticola exilis tytleri</i> NE<br><i>Cisticola e. erythrocephala</i> SW | Zitting cisticola<br><i>Cisticola juncidis</i>             |
| Wet Zone (Sri Lanka & NE India)                                                                        | Dry Zone (Indian subcontinent)                             |
| Blue magpie<br><i>Urocissa</i> sp.                                                                     | Treepie<br><i>Dendrocitta</i> sp.                          |

the dry zone (A1, A2) as well as wet zone species/ population (B2) of peninsular India will group together to the exclusion of those from NE India (Fig. 2B). This model would predict a single faunal colonization of the Indian subcontinent and subsequent divergence into wet zone and dry zone forms. In this case, the morphology-based classification scheme does not agree with the molecular phylogeny and is erroneously suggesting disjunct distribution. In such cases the classification scheme should be revised so as to make it consistent with the molecular data. In addition, wet zone population (B2) of peninsular India must be assigned to a new species. Thus molecular phylogenetic approaches are an important tool in resolving the classification of various organisms and in the study of biogeography and evolution of a species.

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Have you any relationship with nature, with the birds, with the water of that river? All rivers are holy, but getting more and more polluted: you may call it Ganga, or the Thames, the Nile, the Rhine, the Mississippi, or the Volga. What is your relationship with all that - With the trees, with the birds, with all the living things that we call nature? Aren't we part of all that? So, aren't we the environment? If you hurt nature you are hurting yourself.

- J Krishnamurti  
(1895-1986)

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